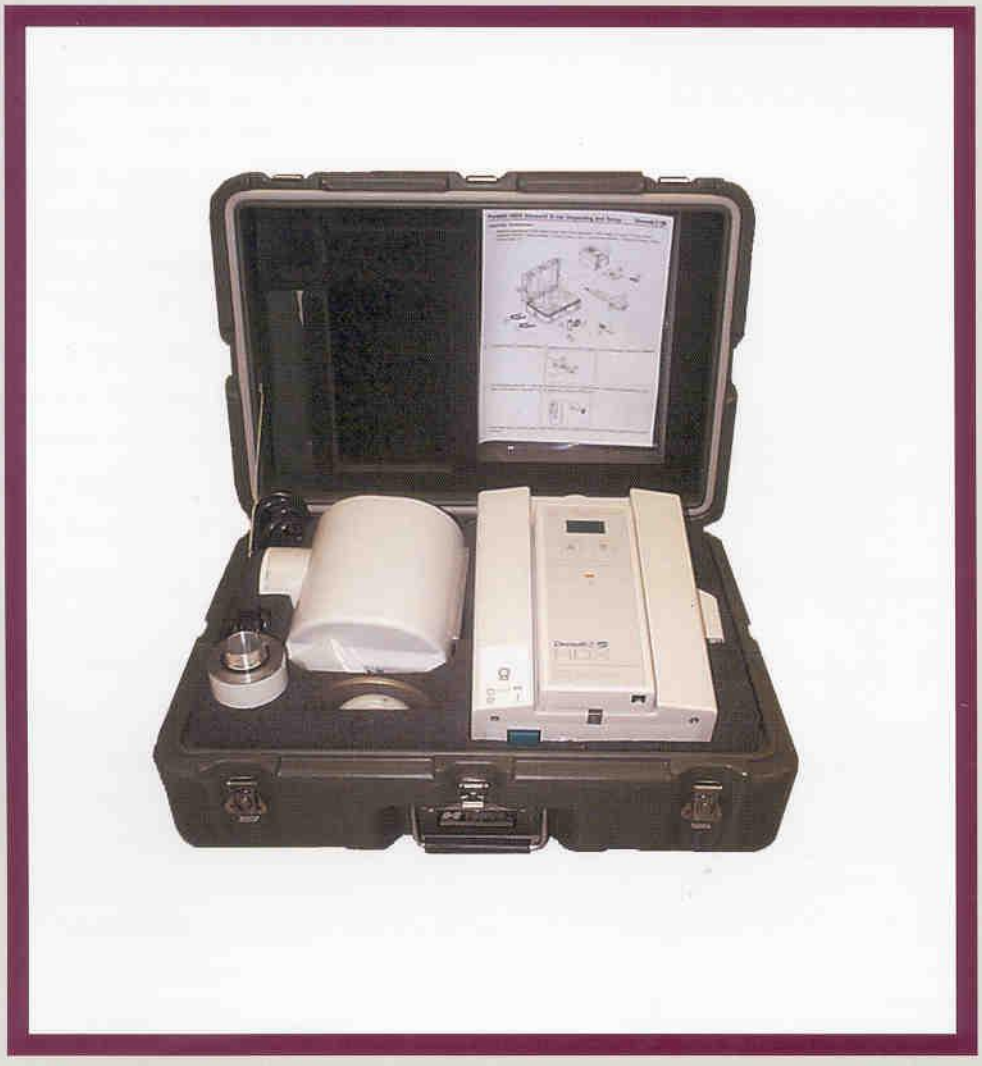
Contractor:

DENT-X

Manufacturer:

DentalEZ

X-ray Apparatus, Dental, Field, Hand Held



Portable HDX Intraoral X-ray

Installation, Operation & Maintenance Manual

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Section I Introduction

DentalEZ

This manual contains installation, operation, and maintenance instructions for the **DentalEZ® Portable HDX Intraoral X-ray System**. These procedures should only be performed by an maintenance service technician experienced in installing and servicing dental X-ray systems.

WARNING:

This X-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed.

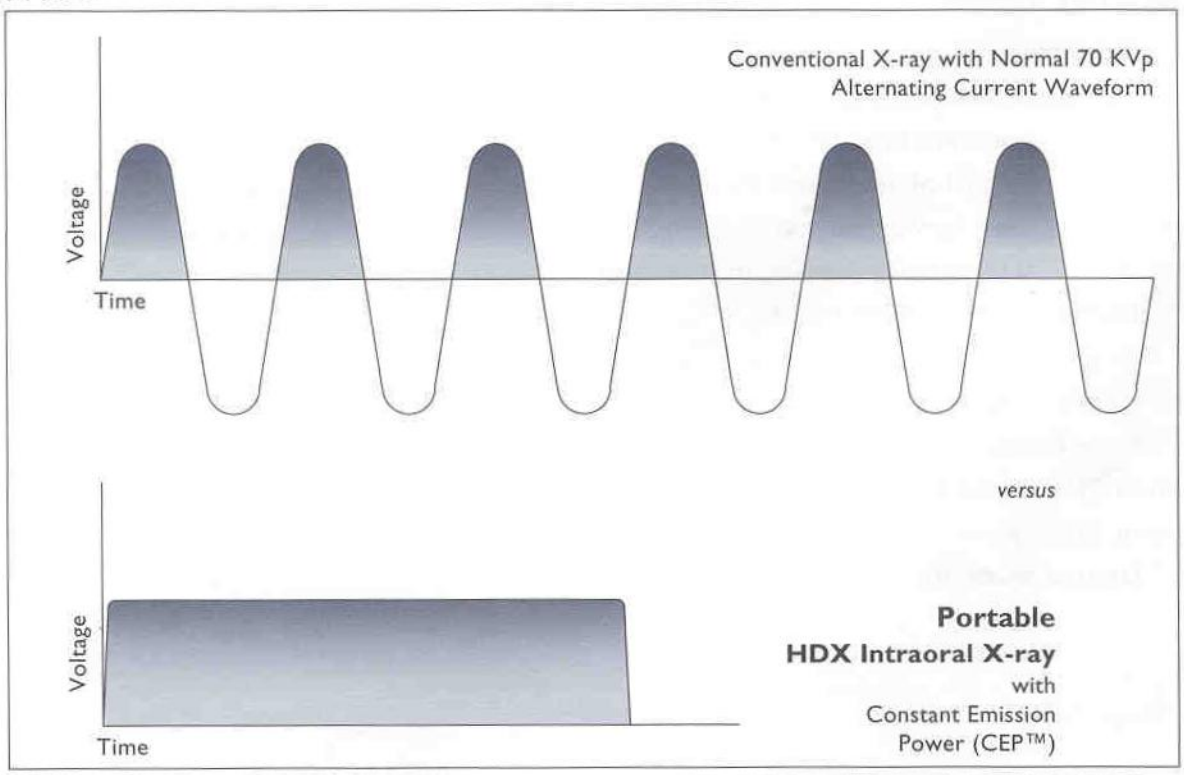
After installing the Portable X-ray, please review the **Operation Section**, the **Maintenance Section**, the **Exposure Time Chart** and **Darkroom Practices and Procedures** with the staff.

Portable HDX Intraoral X-ray Features

- Microcomputer and specialized circuitry that monitors and precisely regulates the exposure technique factors (kV, mA, and exposure time)
- Compatible with a wide range of 120 and 240 line voltage conditions
- Self-diagnostic control panel
- Up and down arrows to change time setting by .01 second increments
- Very short exposure time
- Transportable.

Constant Emission Power (CEP™) Technology

The HDX CEP™ Portable X-ray emits continuously during an exposure rather than in bursts as in conventional X-rays as illustrated. "Constant potential dental X-ray machines can reduce radiation dose by up to 30% . . .".*



* Compendium Report, May 1993, Vol. XIV, No. 5, article *"X-radiation: Potential Risks and Dose Reduction Mechanisms."*

Fig. 1 Comparison with x-ray outputs from AC & DC systems

Portable HDX x-ray Components

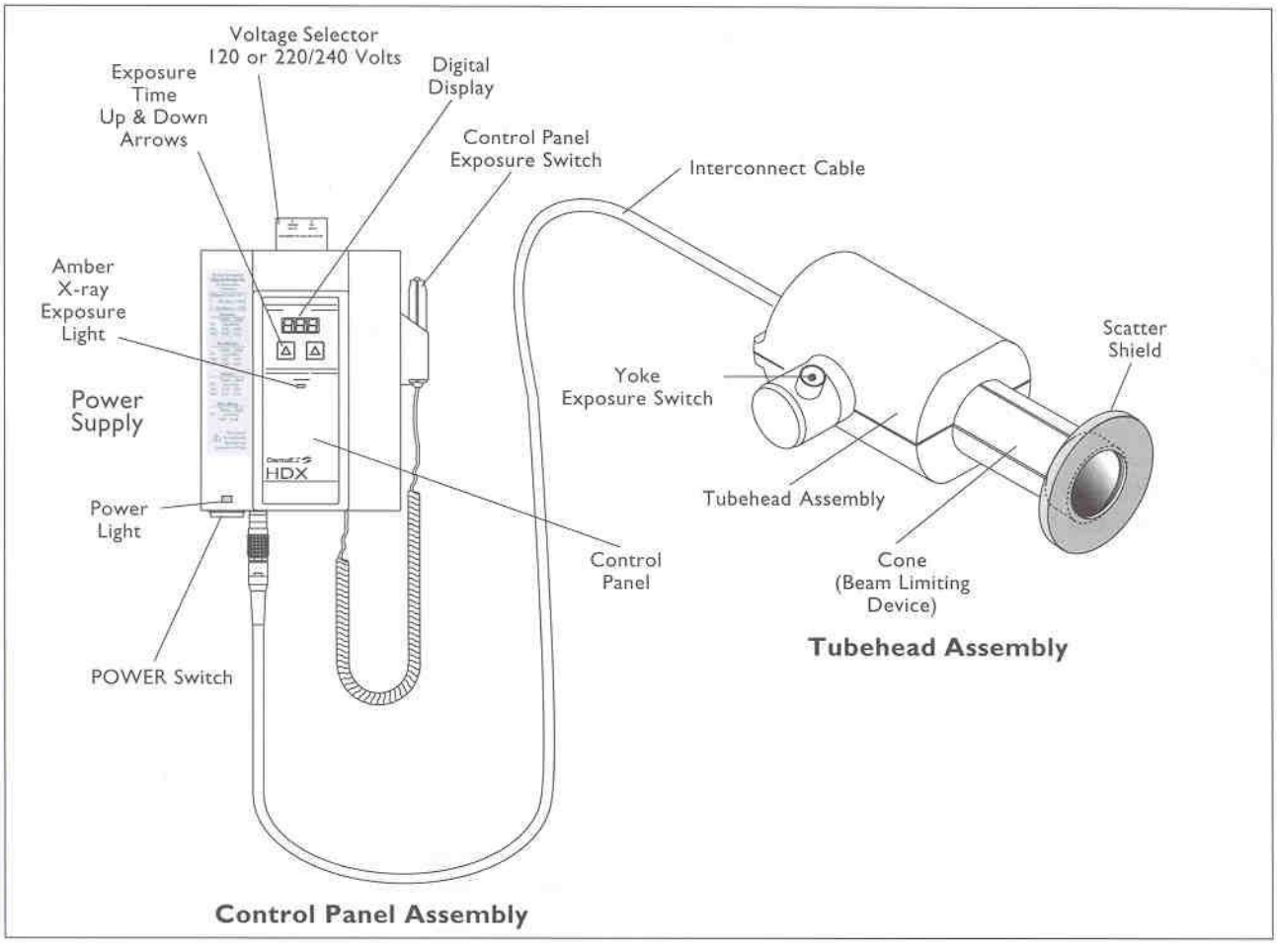


Fig. 2 System Components Identified

Product Description:

The portable HDX x-ray system is an advanced high frequency field dental x-ray apparatus rated at 65 kVDC and 7 mA which is designed to produce diagnostic quality x-ray for film and filmless imaging techniques. When x-rays are taken, the tubehead can be either hand-held or mounted on a tripod (not supplied).

The system consist of two (2) major components: a Control Panel Assembly and a Tubehead Assembly, packaged in a suitably designed rugged case. An appropiate switch is provided which allows normal operation when the system is connected to either a 120 VAC or a 240 VAC, 50/60 Hertz power source.

Section II Certification & Records

DentalEZ®

DentalEZ® certifies that this equipment complies with applicable Regulations and Standards when assembled, checked, calibrated, and maintained in accordance with the instructions in this manual.

The installer is responsible for:

1. Installing the Portable X-ray in accordance with the manufacturer's instructions.
2. Checking the calibration of the machine and performing the calibration procedures when required.
3. Maintaining records of the location of the equipment. Use the Maintenance Record below for this purpose.
4. Providing the **Installation, Operation and Maintenance Manual** to the user who is responsible for maintaining the manual for future reference.

Tubehead Model No._____

Serial No._____

Cone Model No._____

Serial No._____

Control Panel Model No._____

Serial No._____

• Manufactured by: **DentalEZ®**, Lancaster, PA, USA •

This product complies with DHHS standards under the Radiation Control for Health and Safety Act of 1968 applicable at date of manufacture.

Maintenance Record

Install Maintenance By	**Date**	**Checks & Calibration By**	**Date**
Routine Maintenance By	**Date**	**Checks & Calibration By**	**Date**

Chart 1 Maintenance Record

Product Safety/Warning Statements and Symbols used in this manual and on the Portable HDX X-ray System.

Note: Read all special safety instructions and warnings in this manual, and carefully note the meanings of each.

Alternating current

Attention, consult accompanying documents

Dangerous voltage

Fuse

IN-position of the Main Switch

OUT-position of the Main Switch

Ionizing radiation

OFF (power)

ON (power)

Protective earth (ground)

Type B

X-ray source assembly

X-ray source assembly: emitting

Section IV Installation

Unpacking the Components

Components of the Portable HDX x-ray

System Contents

Carrier Case
Tubehead Assembly
Assembly Instructions
Control Panel
20 cm Round Cone
Instruction Manual
International Power Cord
NorthAmerican Power Cord
Shield, Scatter, Cone
Interconnect Cable
Fuses 5 amp Slo Blo - 3 Pcs. } 120 Volts
¼ amp Slo Blo - 2 Pcs. }
3 amp Slo Blo - 3 Pcs } 240 Volts
1/8 amp Slo Blo - 2 Pcs. }

Tools Required

Fluke® 73 Digital Multimeter** or equivalent
Digital™ Pulse Counter, EDS Model XR201* or equivalent
Phillips Head Screwdriver (small and medium)
Slotted Screwdrivers (small and medium)
Allen wrench 5/64".
Needle nose pliers, 6"
Adjustable wrench, 6"

** Fluke® is a registered trademark of the Fluke, Corp., Everett, WA.

* EDS® is a registered trademark of Engineered Design System, Wilmington, DE.

Installation of the Tubehead and Cone

Note: *The cone has no filters attached.*

Verify O-ring is on threaded base of cone.

Thread cone into Tubehead, and align grooves.

For hand held use, slide scatter shield flush to Cone.

CAUTION: *Do not install Tubehead if an oil leak is evident. Always return Tubehead assembly to the factory for repair or replacement.*

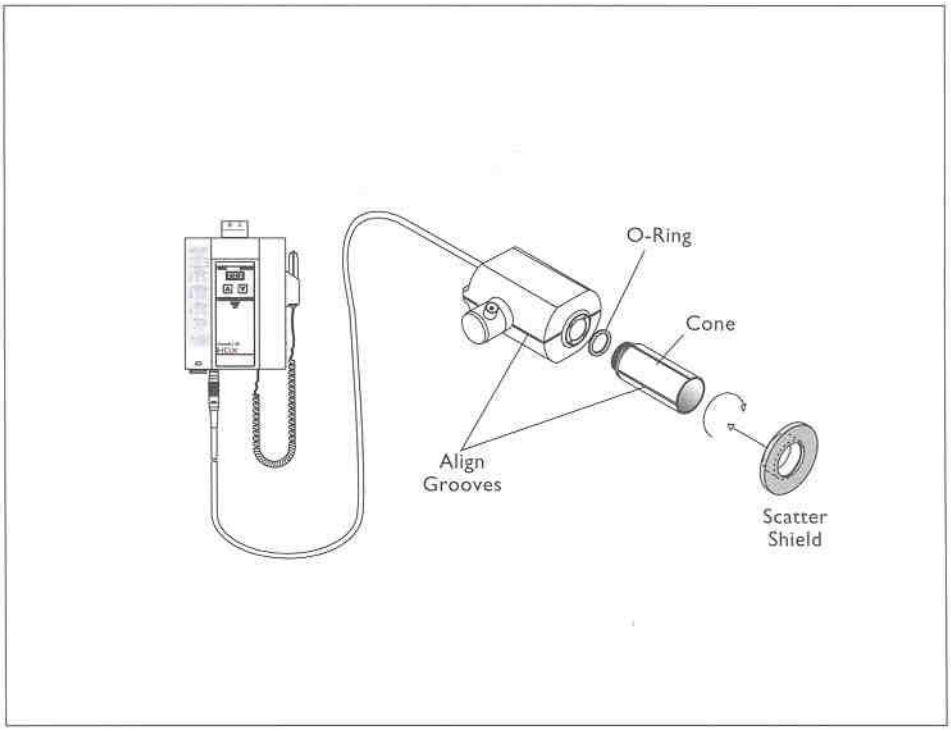


Fig. 3 Installation of Cone and Shield to Tubehead

Assembly Instructions

1. Measure and determine the power supply line voltage and amperage. The supply must be rated between either:
   A. 100 to 130 VAC, single phase and 10 Amperes, 50/60 Hz. or
   B. 200 to 260 VAC, single phase and 5 Amperes, 50/60 Hz.
2. Remove top cover of Voltage Selector Switch receptacle, turn Voltage Selector Switch knob to either 120 VAC or 240 VAC setting, then replace top cover.

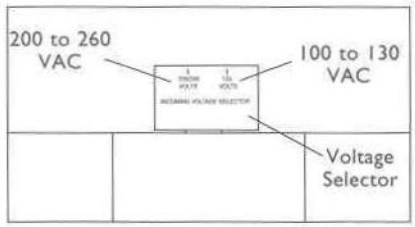


Fig. 4 Power Supply Front view

3. FOR 120 VOLT OPERATION:
   A. Insert two 5 Amp fuses into Main Fuse holders located in bottom left side of power supply.
   B. Insert 1/4 Amp fuse into I/O Fuse holder in bottom of power supply.

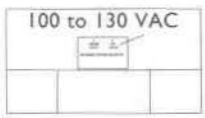
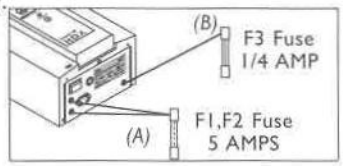


Fig. 5 Voltage Selector



4. FOR 240 VOLT OPERATION:
   A. Insert two 3 Amp fuses into Main Fuse holders located in bottom left side of power supply.
   B. Insert 1/8 Amp fuse into I/O Fuse holder in bottom of power supply.

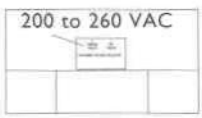
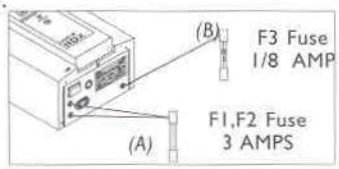


Fig. 6 Voltage Selector



5. Select either 120 volt or 240 volt power supply cord. Insert proper end into receptacle in bottom of power supply.
6. Insert connector on end of Tubehead Interconnecting Cable into round receptacle in bottom of power supply.
7. For either hand-held or tripod mounted use of Tubehead, install cone to threaded opening on front of Tubehead by turning cone clockwise until seated.
   A. FOR TRIPOD operation of Tubehead - Turn Tubehead on its side over top of a tripod and turn ¼-20 screw on tripod into threaded hole in side of yoke.

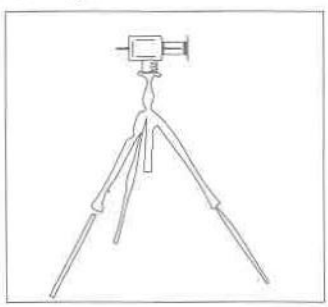


Fig. 7 Assembly of Tubehead to tripod

   B. For HAND-HELD operation of Tubehead - Slide Shield Scatter over front end of cone (*See figure 3.*)

Section V System Checks and Calibration

DentalEZ

System Checks – General Information

The Portable X-ray is factory calibrated and should not require adjustment during installation. However, upon installation perform the preliminary checks listed below and again during annual maintenance. If these checks and calibrations are not performed, compliance with regulations cannot be assured.

RADIATION HAZARD: *Do not use X-ray if it fails preliminary checks, or if it cannot be calibrated. DO NOT operate X-ray until repair is complete.*

Note: *Refer to* **Maintenance Service Information (Section XI, pages 24-42)** *for replacement of components. If a problem persists contact* **Dental**EZ® *Customer Service for technical assistance.*

Preliminary Checks

Item	Check
Labels	Verify that labels for the following components are legible and in place: • Tubehead Assembly • Control Panel • Cone
Other Labels	Verify legibility of all other labels.
Warning Statement	Verify legibility of warning statement on the power supply cover.
Tubehead	Check for oil leaks. **If found, return Tubehead to factory for replacement.**
Cone (BLD)	Inspect for damage. Lead lining must cover entire interior surface of cone. Replace cone if necessary.
Control Panel Exposure Switch or Tubehead Exposure Switch	Inspect cord for damage. Switch operation should be smooth and positive. Replace if damaged.

RADIATION HAZARD: *X-rays are emitted when control panel is energized, and either exposure switch is activated. Unauthorized use is prohibited.*

Line Voltage	Measure incoming line voltage at the Incoming Power Receptacle. Voltage range under load is either 100 to 130 VAC or 200 to 260 VAC. If outside of these limits, DO NOT ATTEMPT TO OPERATE THIS SYSTEM. Contact an electrician or local power utility company to correct.

Calibration Checks and System Checks

To complete installation, follow these steps:

- Preliminary checks
- Power-ON sequence checks
- Line voltage regulation check
- Calibration checks for kV and mA
- Calibration procedure, if required

Power-ON Sequence Refer to **Page 11, Operation,** to turn system ON.

RADIATION HAZARD: *While performing the checking and calibrating procedure, either block the end of the cone with lead or aim the cone in a safe direction away from any person.*

Calibration Check for kV and mA

Note: *The X-ray is factory calibrated and SHOULD require only a calibration check during installation.*

The mA and kV sense voltages can be checked without removing the power supply cover.

Remove yoke end cap.

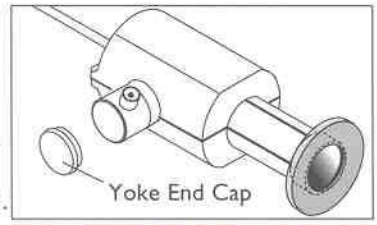


Fig. 8 Yoke End Cap

Connect multimeter to terminals inside of yoke following the chart 2.

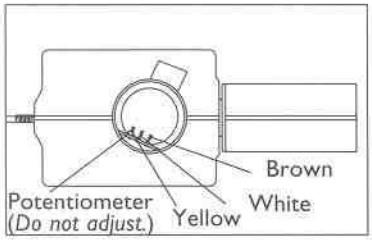


Fig. 9 kV & mA Test Points

CAUTION: *Before taking any long exposures to check calibration, take several 0.10 second exposures waiting 15 seconds between exposures. The microprocessor is programmed to prevent an operator from exceeding the system duty cycle.*

Check	Meter	Power Switch	Exposure Setting	Exposure Switch	Meter Reads
kV	Multimeter to Yoke: (+) lead toYellow (-) to White	ON	2.00 seconds	Press & Read Meter	+6.4 to +6.6 VDC
mA	Multimeter to Yoke: (+) lead to Brown (-) lead to White				+6.8 to +7.2 VDC
Time	Digital Impulse Counter (XR201): Place in front of cone				2.00 +/-0.02 sec.

Chart 2 Calibration Settings

If kV, mA, and time are within limits as listed in the above chart the system is calibrated. Reinstall yoke end cap

If any of the kV, mA, or time readings are out of range, continue **Calibration**.

Measure Line Regulation

1. Measure incoming line voltage. (See figure 10.)
2. Set timer to 2 second exposure time.
3. Make exposure while reading multimeter.

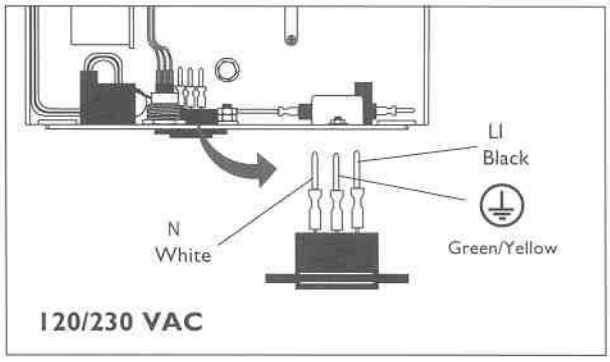


Fig. 10 Input Line Voltage Measurment Points

4. Calculate line regulation as follows:

$$\text{Regulation \%} = 100 \times (V_{NL} - V_L)/V_L$$

where V_{NL} = voltage with no load

V_L = voltage under load.

Examples:	**120 Volts**	**230-240 Volts**
No load voltage	= 118 volts	= 236
voltage under load	= 115 volts	= 230
Regulation %	= 100 x (118-115)/115	= 100 x (236 -230)/230
	= 100 x 3V/115	= 100 x 6V/230
	= 100 x .026	= 100 x .026
	= 2.6%	= 2.6%

Result of either example is within 4% tolerance.

If not within 4%, call the local utility company. If the under load voltage is not within operating range (100 to 130 VAC or 200 to 260 VAC), install a 1.5 kVA buck-boost transformer. Remeasure line regulation after installing transformer.

Setup for Calibration

SHOCK HAZARD: *All circuits inside power supply are at dangerous voltage levels. TURN POWER OFF WHEN CONNECTING MULTIMETER LEADS OR MOVING JUMPER. Use an insulated adjustment tool.*

CAUTION: *Wait 4 minutes for capacitors to discharge after power is OFF. Voltage at red and green wires must be below 2 VDC before connecting control panel.*

Remove control panel from mounting bracket on front of power supply cover. Unplug the 7-pin and 4-pin connectors.

Remove power supply cover.

Reconnect 7-Pin and 4-Pin connectors on control panel.

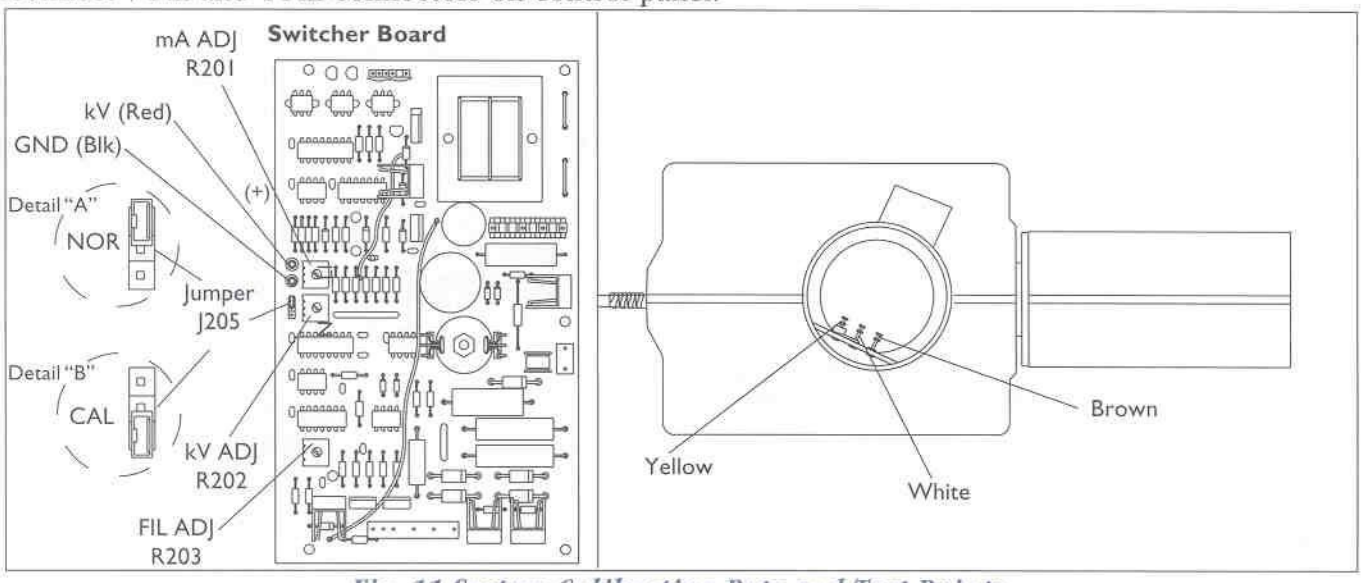


Fig. 11 System Calibration Pots and Test Points

Calibration

Chart 3 Calibration Settings

CALIBRATION	J205	Adjust	Yellow	White	Brown	Power	Timer	Exposure
FIL mA 7.4 VDC to 7.6 VDC	CAL	R203	N/A	GRND	Pos (+)	ON	2.00	Press, Read, Adjust
Fine mA 6.8 VDC to 7.2 VDC	NOR	R201		(-)				
KVP 6.4 VDC to 6.6 VDC		R202	Black (+)	Neg	N/A			

RADIATION HAZARD: *While performing the checking and calibrating procedure, either block the end of the cone with lead or aim the cone in a safe direction away from any person.*

Note: *A nonconductive screwdriver is included inside the power supply for adjustments.* **DO NOT** *use a metal screwdriver for the following steps.*

Turn power OFF.

Place jumper J205 in the CAL (*See figure 11 above, Detail B*).

Connect the meter to the contacts behind the yoke cover as follows: (-) lead to the white terminal and the (+) lead to the brown terminal.

Set the meter to read +8.00 VDC.

Turn the power switch ON.

IMPORTANT: *Turn R201, R202, and R203 (FIL) counterclockwise until stopped. Then turn each potentiometer 1/8th of a turn (45°) clockwise.*

Set the exposure time to 2.00 seconds.

Press and hold the exposure switch and read the meter.

Adjust R203 (FIL) until multimeter reads +7.40 to +7.60 VDC during exposures.

Turn the power switch OFF.

Place jumper J205 in NOR (*See figure 11 above, Detail A*) position.

Turn the power switch ON.

Using 2.00 second exposures, adjust R201 (mA) until meter reads between +6.80 and +7.20 VDC during exposures.

Move the (+) meter lead from brown to yellow terminal.

Using 2.00 second exposures, adjust R202 (kV) until meter reads between +6.40 and +6.60 VDC during exposures.

Calibration is complete; turn X-ray OFF. Assemble all covers carefully.

Turning the System ON & Self Diagnostics

RADIATION HAZARD: *Observe safe exposure factors and operating instructions as the portable X-ray may be dangerous to patient and operator.*

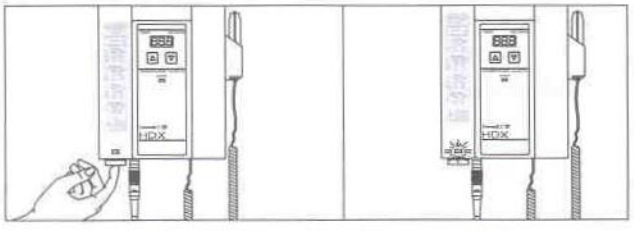


Fig. 12 Turning System ON

CAUTION: *If the following sequence does not occur, refer to* **User Service Information.**

Fig. 13 Software Revision Level Display

Fig. 14 Software Checksum Display

Note: *The computer calculates the checksum, and if correct, displays CHS (a standard software signal) for one second. If checksum is* **not** *correct, the control panel displays error code E11, and disconnects. Turn power OFF, and replace control panel.*

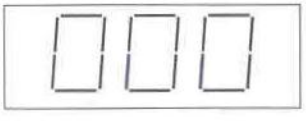


Fig. 15 Number of Unit Exposures Display (in thousands)

New installations display 000.

Note: *When the exposure count reaches 149 thousand, the display flashes 4 times and a chime sounds 4 times. To continue exposure count, call for maintenance for service.*

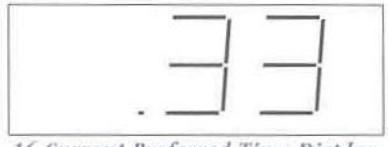


Fig. 16 Current Preferred Time Display

Note: *The* **Preferred Time** *is the preset exposure time when the system is initially turned ON. It displays in seconds to two decimal places. For example:*

.38 is an exposure time of 0.38 seconds;

1.88 is an exposure time of 1.88 seconds.

The X-ray is now in standby, ready for one of five separate actions, A through E.

A. Standby Condition

The X-ray may be left in standby indefinitely.

B. Adjusting the Exposure Time

Note: *If an exposure time other than the preferred time is selected and the system is turned OFF, when the system is turned ON, the preferred time will again be displayed.*

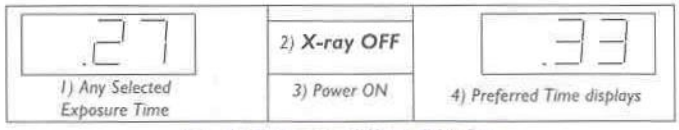


Fig. 17 Exposure Time Display

To change the exposure time, press the UP button to increase or the DOWN button to decrease.

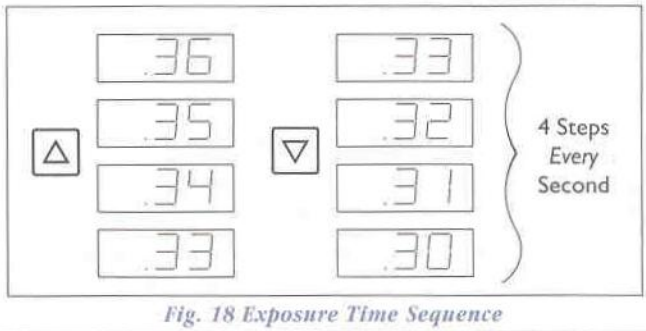


Fig. 18 Exposure Time Sequence

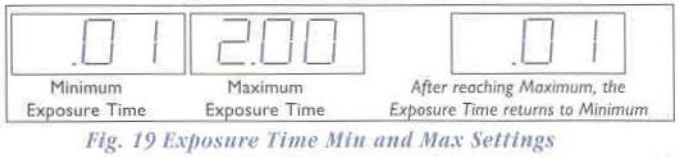
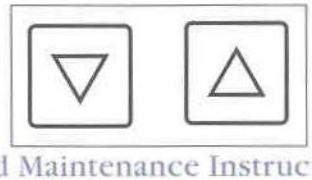


Fig. 19 Exposure Time Min and Max Settings

To change the preferred time setting, simultaneously press and release both the UP and DOWN arrows.

Fig. 20 Exposure Time Change Buttons



The control panel is now in the Preferred Time Adjust Mode, as indicated by the blinking decimal point and the chime sounding 2 times per second. Select the new Preferred Time by pressing the UP or DOWN arrow.

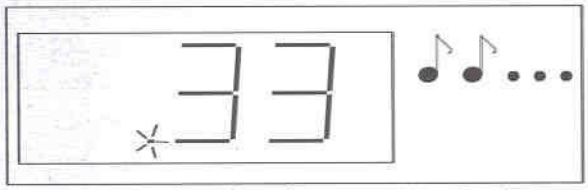


Fig. 21 Preferred Exposure Time Setting

When the display shows the new desired Preferred Time, turn the system OFF to store the *new* time in permanent memory.

Wait 5 seconds.

Turn the system ON. The *new preferred* time is now displayed.

C. Making an Exposure

CAUTION: *Always observe the system duty cycle. One 0.25 second X-ray exposure can be made every 15 seconds.*

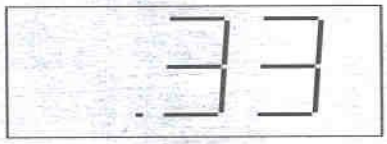


Fig. 22 Select Exposure Time

Press and hold exposure switch until chime sounds.

Release switch.

Note: *After pressing the exposure switch, power is applied to the X-ray tube filament, which takes 0.6 seconds to become fully operational. Then the exposure begins, as indicated by the amber X-ray light. At the end of the exposure, the X-ray light turns OFF, and the chime sounds.*

Error codes:

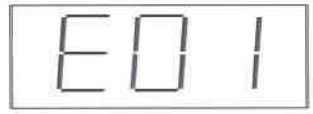


Fig. 23 Exposure Switch released too soon. . .

Note: ***Release switch within 15 seconds after chime sounds. If exposure switch is depressed too long, error code E02 appears. Refer to*** **User Service Information** ***for other error codes.***

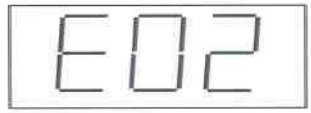


Fig. 24 Switch held too long.

Replace the exposure switch in its holder.

If an error code displays during an exposure, refer to **User Service Information.**

D. Turning the System OFF

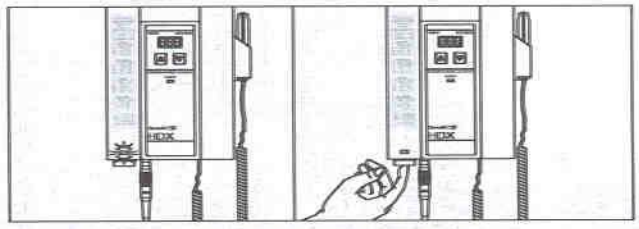


Fig. 25 Turning System OFF.

Automatic duty cycle control: If an operator inadvertently tries to initiate two consecutive exposures without waiting for the X-ray tube to cool down between the exposures, the microprocessor in the control panel is programmed to automatically protect the X-ray tube. After each exposure, an OFF interval equal to 60 times the last emission duration is provided. Any combinations of 1 second of exposure per minute can be made (e.g. four 0.25 second or two 0.50 second exposures).

System cleaning information:

1. Cones (BLDs): Use non-alcohol based disinfectant only (liquid or spray). Can be cleaned while assembled to Tubehead.

2. All other parts: Use cloth dampened with mild soapy water.

DentalEZ Hand Held X-ray System
Suggested Exposure Time Settings

(8" Source-Skin Distance)

Speed Group D (Kodak Ultraspeed) Exposure Time	**Incisors** Adult Child (Seconds)	**Pre-Molars** Adult Child (Seconds)	**Molars** Adult Child (Seconds)	**Bite-Wing** Adult Child (Seconds)
Maxillary	0.22 .014	0.27 0.18	0.33 0.23	0.27 0.18
Mandibular	0.18 0.12	0.22 0.14	0.27 0.18	
Speed Group D/E (Agfa M2) Exposure Time	**Incisors** Adult Child (Seconds)	**Pre-Molars** Adult Child (Seconds)	**Molars** Adult Child (Seconds)	**Bite-wing** Adult Child (Seconds)
Maxillary	0.15 0.10	0.18 0.12	0.23 0.15	0.18 0.12
Mandibular	0.11 0.08	0.15 0.10	0.18 0.12	
Speed Group E (Kodak Ektaspeed) Exposure Time	**Incisors** Adult Child (Seconds)	**Pre-Molars** Adult Child (Seconds)	**Molars** Adult Child (Seconds)	**Bite-wings** Adult Child (Seconds)
Maxillary	0.12 0.08	0.15 0.10	0.19 0.13	0.15 0.10
Mandibular	0.10 0.07	0.12 0.08	0.15 0.10	

Chart 4 Suggested Exposure Times

1. The above are suggested nominal exposure times. Adjust as needed to meet your density preference.
2. Check proper developer temperature, and verify freshness of chemicals prior to changing exposures.

Darkroom Practices and Procedures

I. General:

The standardization of the film exposing / film handling / film processing techniques will result in sharp and contrasty x-ray films which are rich with diagnostic information. Any deviation(s) from the routine will usually reduce the film contrast thus making it more difficult to see detail(s) in the film. Also, a properly processed film minimizes the patient radiation exposure.

II. Darkroom Recommendations:

(manual and automatic processors)

A good darkroom should be large enough so that there are "dry" and "wet" areas. The safelight should include a 15 watt (maximum) frosted light bulb and known filter (for example, a Kodak GBX-1 or equal) designed to be used with the film used, and be positioned at least four (4) feet from the dry areas (if a film other than Kodak is used, we suggest contacting the film manufacturer for their recommendations). Further, to prevent fogging of the films, the darkroom must be light tight - especially important if the user is using Speed Group "E" (e.g. Kodak EKTASPEED) film which is more sensitive than "D" film (ULTRA-SPEED) to unsafe light condition(s).

- **To check for unsafe light leak(s) in the darkroom:** With the safelight turned OFF, close the darkroom door and wait in the darkroom for about 5 minutes for your eyes to adjust to the darkness. Check darkroom for light leaks around the door, vents, cracks, ceilings tiles etc... If unsafe light sources are found, eliminate them using weather stripping, tape etc...

A. If Darkroom Equipped With:

- **Manual Hand Tanks:**

A darkroom which has a manual developing tank installed in it should consist of the following items (as minimum):

A. Hand-Tank with 1 gallon solution inserts.
B. Thermostatic water temperature control valve.
C. Safelight [it should include a 15 watt (maximum) frosted light bulb and a known light filter - for example, a Kodak cat no. GBX-1 Safelight or equal]
D. Floating Thermometer.
E. Accurate darkroom timer.
F. Solution stirring paddles (one for the developer and one for the fixer insert).
G. Scrub brushes (one for the developer and one for the fixer insert).
H. A chart for listing the date when the solutions were last changed.

Simplified Developing Procedure:
Ideally, we recommend that you follow the solution manufacturer's recommendations - or follow this simplified developing procedure.

Note: For consistent results, we recommend replenishing the developer and fixer solutions (using a second set of solutions) after processing:

- 75 Intraoral films (all sizes), or ...
- Three - 8" x 10" films, or ...
- Any combination of the above (one 8" x 10" film approximately equals 25 intraoral films)

Developer: One (1) ounce of developer concentrate diluted with two (2) ounces of water.
Stir with developer paddle.

Fixer: One (1) ounce of fixer concentrate (do not dilute).
Stir with fixer paddle.

- **Automatic Processing System**

A darkroom which has an automatic processing system installed in it should consist of the following items (as minimum):

B. Safelight [it should include a 15 watt (maximum) frosted light bulb and a known light filter - for example, a Kodak cat no. GBX-1 Safelight or equal]
C. Paddles for stirring the solutions (one for the developer and one for the fixer tank).
D. Scrub brushes (one for the developer and one for the fixer insert).
E. A Thermometer.

An automatic film processor will standardize your film processing technique provided the system is maintained in accordance with the procedure recommended by the manufacturer. If the processor is installed in the darkroom, the above safelight recommendations, positioning of it relative to the "dry" area, and the procedure to check for light leak(s) apply.

- **Important Tips:**

1. Your automatic film processor may or may not be equipped with the automatic solution replenishment feature:

   For those intraoral only processors without automatic solution replenishment:

   8 ounces of working strength developer and fixer replenisher should be added to each solution daily or after processing 20 to 30 films. Also, it is recommended that the solutions be changed every 3 to 4 weeks.

   For those larger processor equipped with automatic solution replenishment:

   A. Each time it is turned "ON", allow sufficient time for the solutions to be heated up to operating temperature or else light films may be produced.
   B. Each time the processor is turned "ON", check the solution levels in the replenisher developer and fixer tanks to make sure sufficient solutions are available to process the desired number of films, and stir each solution in the replenisher tank (use separate paddles) before processing the films.

2. For those processors equipped with daylight loaders:
   It is important that the processor be install in an area of subdued lighting. This will help reduce the possibility of light fogging the films.

III. Common Film Problems

Three of the most common x-ray film problems encountered are:

- A) Films are too light (not enough density)
- B) Films are too dark (too much density)
- C) Films lack contrast (Cannot easily see diagnostic detail)

A) FILMS ARE TOO LIGHT (not enough density):

Light films may be caused by one or more of the following:

1. Too short X-ray exposure time selected.
2. Slower speed film being used
3. Short developing time (hand-tank).
4. Developing solutions too cold.
5. Developing solutions exhausted.
6. X-ray machine defective.

1. **Too short X-ray exposure time selected:**

   Check HDX Suggested exposure Time Setting Chart to verify that correct exposure time has been set for the speed of the film being used, and for the tooth being examined.

2. **Slower speed film being used:**

   If Speed "E" film (e.g. Kodak EKTASPEED) is routinely used, perhaps Speed "D" (e.g. ULTRA-SPEED Kodak) is being exposed. Check film packet (and box) to verify brand name/speed of film.

3. **Developing solutions too cold:**

   If the films are too light when the recommended developing time is followed, then the solutions may be too cold. If manual tank - add warm water to the water bath (not solutions) until the solutions are at the recommended temperature (usually 68 degrees F). If automatic film processor - if solutions are too cold after turning ON the processor, did you allow enough time for the heater(s) to warm up solutions? If yes, repair the film processor as needed.

4. **Short developing time (hand-tank system):**

   Be sure to follow the time/temperature developing recommendations provided by the solutions manufacturer. If the films are removed from the developing solution prematurely after 1 minute or so, only those areas of the film emulsion which received a large amount of radiation will darken and be visible - the areas of the emulsion which received a lesser amount of radiation will not darken sufficiently to be visible and as a result, many of the subtle grays will not be visible and thus valuable diagnostic information will be lost. Further, the films will lack contrast and some darkness which makes it more difficult to visualize diagnostic details.

5. **Developing solutions exhausted:**

   Films processed in solutions which are exhausted will be lighter than normal and will lack contrast (like reusing coffee grounds to brew another pot of coffee). Follow the Simplified Replenishment Procedure above or the manufacturer's recommendations to maintain consistent developing results month-to-month.

6. **X-ray machine defective:**

   Perhaps the actual X-ray exposure is shorter than what the timer indicator reads. Suggest using your time counter to verify the exposure time. If incorrect, troubleshoot and repair the X-ray machine as necessary.

B) FILMS ARE TOO DARK (too much density):

1 .Too long X-ray exposure time selected.
2. Faster speed film being used.
3. Short cone installed on X-ray but exposure time set for long cone.
4. Developing solutions too hot.
5. X-ray machine defective.

1. Too long X-ray exposure time selected:

Check HDX Suggested Exposure Time Setting Chart to verify that correct exposure time has been set for the speed of the film being used, and for the tooth being examined.

Note: *The actual exposure time setting on the X-ray is usually within 25% of the suggested setting on the correct chart. If it is not, reset the x-ray timer and retake and process the film, if the density of the film is still too dark, it may be fogged.*

2. Faster speed film being used:

If Speed "D" (e.g. Kodak ULTRASPEED) is routinely used, perhaps Speed "E" film (e.g. Kodak EKTASPEED) is being exposed. Check film packet (and box) to verify brand name/speed of film.

3. Developing, solutions too hot:

Manual Hand Tank: If the films are too dark when the recommended development time is followed then the solutions may be too hot. Add ice cubes to the water bath (not solutions) until the solutions are at the recommended temperature (usually 68 degrees F).

4. X-ray machine defective:

Perhaps the actual X-ray exposure is longer than what the timer indicator reads. Suggest using your time counter to verify the exposure time. If incorrect, troubleshoot and repair the X-ray machine as necessary.

C) FILMS LACK CONTRAST (cannot easily see diagnostic detail):

If the film lacks contrast and is too dark, it may be fogged. Fog is usually caused by any 1 or more of the following conditions:

a.) An unsafe light condition.
b.) The processing chemicals.
c.) An unsafe film storage location.

Procedure to determine whether the film is fogged.

To determine if a film is fogged, place a dry processed film(s) which has either a large amalgam filing or a gold crown directly on top of this page.

Read the printing on this page through the filing or crown. You should be able to read it easily because these areas should be "window-panel clear" (the X-rays do not have sufficient power to penetrate either of them and thus expose the film). If you cannot read easily the printing, then the film is fogged.

Procedure to check for source of fogged films:

1. Unsafe Light Source:

To determine if the films were fogged by an unsafe light in the darkroom, follow these steps:

a. **Light leak(s) in the darkroom:** With the safelight turned OFF, close the darkroom door and wait in the darkroom for about 5 minutes for your eyes to adjust to the darkness. Check darkroom for light leaks around the door, vents, cracks, etc. If unsafe light sources are found, eliminate them using weather stripping, tape etc.

b. **Master film.** In daylight, unwrap a film and place it on a single film hanger. Insert the film and hanger directly into the Fixer solution for about 2 minutes or until it is completely clear. Rinse and dry. This is your master film to which all other films will be composed to.

c. **To determine if the box of film is defective:** In total darkness, remove the film from the film packet and process it immediately in the developer and fixer solutions as though it was an exposed film. If this film is not as clear as the master film, it may be outdated or was stored in an area which was too hot. Try a new box of film and repeat this test.

d. **To determine if the safelight is unsafe:** Turn ON the safelight. Unwrap a film, place a small coin on top of it, and place it on the dry work surface so that it is exposed to the safelight. After 5 minutes, process the film in the same manner as you would process a patient film. If there is no image of the round coin, the safelight is safe- If you see the outline of the coin, the safelight is unsafe. Check to see if the safelight filter is cracked (allowing white light to expose the film), the bulb wattage too large (it must not exceed 15 watts and should be a frosted lamp), or the safelight may be too close to the dry work surface (it should be least 4 feet away).

2. Film Storage (pre and post exposure):

Care in storage of X-ray film is extremely important because film is affected by heat, humidity and, of course, radiation. Ideally, unexposed film should be stored at 50 to 70 degrees F, and 30 to 50 percent relative humidity in an area properly shielded from X-rays. Each package should be placed so that the expiration date is clearly visible so that the film stock is rotated and the older film used first.

A good precaution is to always store X-ray films in leaded storage containers (before and after use). This will protect the films from being exposed to any stray radiation. This applies to exposed films even more so because they are more sensitive after exposure than before exposure.

If you suspect films are being inadvertently exposed, have the assistant take a film on a live patient and immediately process it. If the film does not show any fog, then the usual place where the films are temporarily stored (whether it is in the uniform pocket or on the bracket table) after exposure is unsafe.

3. Chemical Fog Caused by Contaminated Developer/Fixer Chemicals:

Suggest dumping the solutions presently in your system, scrub and rinse thoroughly the developer and fixer tanks.

Note: *Be sure to use a different scrub brush for each tank. A small amount of Fixer on a brush can contaminate the Developer tank. Also, if contaminated, you may detect a faint smell of rotten eggs.*

Hint: When pouring the solutions into the processor internal tanks, **Always Pour the Fixer Solutions First** and very slowly to prevent any fixer solution from splashing into the developer tank (the fixer solution can tolerate a small amount of developing solution which is normally carried over by the film during the processing cycle) and contaminating the solutions again.

For additional information on X-ray exposure and image receptor (film) processing techniques, we suggest following the procedures recommended by your film processor manufacturer and/or the following enclosed Eastman Kodak publications:

1. Successful Intraoral Radiography (N418).
2. Exposure and Processing for Dental Radiography (N413).
3. Quality Assurance in Dental Radiography (N-416)

The calibration of the system must be checked on an annual basis to assure continued compliance with regulations that were applicable at the time of manufacture. Failure to have the following annual maintenance performed by authorized and qualified maintenance personnel relieves DentalEZ and its agent(s) of all regulatory responsibilities.

1. Perform the Preliminary System Checks on page 8 of this manual.
2. Calibration check for kV and mA:
   A. Remove yoke end cap and connect (place) meters as per chart 5:

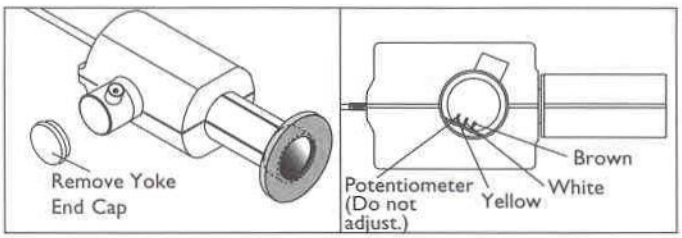


Fig. 26 kV and mA Test Points

Check	Meter	Power Switch	Exposure Setting	Exposure Switch	Meter Reads
kV	Multimeter to Yoke: (+) lead toYellow (-) to White	ON	2.00 seconds	Press & Read Meter	+6.4 to +6.6 VDC
mA	Multimeter to Yoke: (+) lead to Brown (-) lead to White				+6.8 to +7.2 VDC
Time	Digital Impulse Counter (XR201): Place in front of cone				2.00 +/-0.02 sec.

Chart 5Calibration Settings

Note: *If kV, mA and exposure time readings are within specified ranges, Reinstall yoke end cap. Calibration check is complete.*

   B. If kV, mA or exposure time are out of specified range, the system must be calibrated.
3. Calibrate the system by following the calibration procedure detailed on page 10.
4. The annual maintenance program is now complete and normal operation can now be resumed.

Section X User Service Information

Notes: 1. *All repairs should be performed by maintenance service personnel to ensure that the system meets all of the radiation safety regulations applicable at the time of manufacturing.*

2. *Error codes E11 and above which are displayed* are fault conditions which must be corrected only by maintenance personnel.

Table 1 User Error Codes

SYMPTOM	PROBLEM	CORRECTIVE ACTION
Power ON light and digital display are not lit.	Primary power OFF.	Check building circuit breaker. If OK, call maintenance personnel for service.
Power ON, and digital display lit but no x-ray produced during attempted exposure.	System connected to 240 volts line but voltage selector set for 120 volts.	Replace T3 fuse with correct rated fuse and set voltage selector switch for 240 volts.
Power ON light is not lit, but digital display is. System operates normally.	Light is inoperable or connector is disconnected.	OK to operate system, but have maintenance personnel correct it.
Digital display does not display all *8*'s during power ON sequence.	Problem with either digital display or display circuit.	Call maintenance personnel for service. Do *not* attempt to use the Portable X-ray because Exposure time cannot be set properly.
Film density too light.	Film is either under exposed or under developed.	Check to make sure that the correct exposure chart is being used. Also refer to **Section VIII , Pages 14-20.** Check the developing procedure.
Film density too dark.	Film is either over exposed or over developed.	Check to make sure that the correct exposure chart is being used. Also refer to **Section VIII , Pages 14-20.** Check the developing procedure.
Film Lacks Contrast	An unsafe light condition, processing and/or an unsafe film storage problem.	Refer to **Darkroom Practices and Procedures, Section VIII , Pages 14-20.**
The following Error codes will be displayed on the digital display when they occur, and the chime will sound for the number of times indicated.		
E01 ♪♪♪	Exposure switch was prematurely released before the end of the exposure.	Error code will clear after 5 seconds. Retake film using new film packet or digital sensor.

(continuation of Table 1)

E02 ♪♪♪	Hand Held Exposure switch or coiled cord or Yoke Exposure Switch pressed for more than 15 seconds after chime sounds or coil cord shorted.	Turn power OFF, wait a few seconds, and turn back ON. If problem persists, replace hand held switch and coiled cord assembly or yoke exposure switch.
E03 ♪♪. . .	The line voltage is below the specified minimum.	Turn power OFF, wait a few minutes. Try again. If problem persists, call maintenance personnel to check incoming line voltage.
	System set for 240 volts, but connected to 120 volts line.	
E04 ♪♪♪	Duty cycle exceeded.	Wait until error message is turned OFF, then continue usage.
E18 ♪♪. .	Low incoming line voltage when power switch turned ON.	Wait a few minutes and try again. If problem persists, call maintenance personnel for service.
	System connected to 120 volts line but voltage selector switch in 240 volt position	Set line selector switch to 120 volt position.
EEP ♪♪♪♪	Faulty EEPROM	Call maintenance personnel for service.
149 *(During Power On Sequence)*	Exposure count has reached 149,000 (the EEPROM will be full at 150,000).	If continued counting of exposures is desired, call maintenance personnel for service. Failure to replace the EEPROM will not affect the operation of the X-ray - the exposure count will simply stop at 150,000.

NOTE: *For all other Error codes, note error code, turn system OFF, and call maintenance personnel for service.*

Section XI Maintenance Service Information

To maintain system compatibility, use only HDX Intraoral X-ray system replacement components/ subassemblies.

SHOCK HAZARD: *Dangerous voltages are present inside the power supply. The operator should never remove the power supply cover.*

WARNING: *Error codes E11 and above are fault conditions that must be corrected or repaired by maintenance personnel. If error code E11 or above is displayed, turn the power switch OFF immediately. For other error codes refer to the troubleshooting tables for corrective action.*

Note: *If the corrective actions listed in this table do not provide a solution to the problem, contact* **DentalEZ®** *Customer Service for technical assistance.*

♪ Chimes	End of exposure
♪♪	Power-ON check
♪♪♪	Errors E01 and E02
♪♪♪♪	Exposure count has reached 149 thousand **
♪♪ . . .	Other error conditions/Preferred Time Adjust Mode

** See ***Troubleshooting Table 2***, for details.

Error codes are prefixed by the letter *E*:

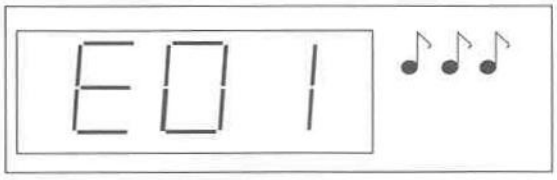


Fig. 27 Error Code Message

E01-E04 error codes = User Service Information

All other error codes = To be performed by maintenance service personnel ONLY.

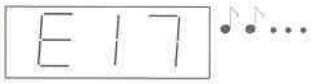
Table 2. Maintenance Personnel Troubleshooting Table

Problem	Cause(s)	Correction
E01 ♪♪♪	Exposure switch released before end of exposure.	Error code clears after 5 second. Take exposure using new film packet or digital sensor.
E02 ♪♪♪	Exposure switch pressed for more than 15 seconds after chime sounds. Exposure switch depressed while changing exposure time. Faulty exposure switch or cord.	Unit will reset in five seconds. Error code clears when exposure switch is released. If error code does not clear, turn power OFF. If error code E17 occurs when power ON, exposure switch or mating cord is damaged. Replace Yoke Exposure Switch with Part No. 303060, or Control Panel Exposure Switch with Part No. 300071.
E03 ♪♪ . . . - - - during standby or during exposure	Line voltage below specified minimum range.	Power OFF; wait a few minutes. Power ON. Retry. If problem persists: Check incoming voltage. Measure line regulation. Contact local utility or install buck/boost transformer.
E04 ♪♪♪	Duty cycle exceeded.	Wait until the digital display indicates the preselected exposure time again.

Note: *Error code E03 is normal and not a default condition, and may occur when power is disconnected to X-ray due to slow discharge of capacitors.*

E01-E04 error codes = User Service Information
All other error codes = To be performed by maintenance service personnel ONLY.

Problem	Cause(s)	Correction
Note: *Error code E11 or higher is indicated by a blinking display and chime sounding twice per second. Note code before turning X-ray OFF.*		
E11 ♪♪...	Software malfunction.	Power OFF; wait a few seconds. Power ON. Retry. If this is an intermittent problem, noise may be present on the line.
E12 ♪♪...	Up switch ON when power ON.	Make sure unit is plugged to an isolated line.
E13 ♪♪...	Down switch ON when power On	If problem persists, replace Control Panel Part. No. 303070
E14 ♪♪...	Head cable disconnected from power supply Assy. Tube Head Intermittent connection	Verify Interconnecting Cable is properly connected to the Power Supply Receptacle. Replace Tube Head Interconnect Cable, Part No. 303062 Send Tube Head to factory for repair.
E15 ♪♪...	Hardware malfunction. REG signal OFF during exposure.	Refer to **Troubleshooting Flow Chart, Page 31.**
E16 ♪♪...	Hardware malfunction. REG signal ON but not during exposure.	Refer to **Troubleshooting Flow Chart, Page 31.**

Problem	Cause(s)	Correction
	Exposure switch ON when power ON.	Replace Control Panel Exposure Switch, Part No. 300071, or Yoke Exposure Switch, Part No. 303060. Or check remote cable connection. Refer to **Troubleshooting Flow Chart, Page 31.**
	Incorrect Position of the Voltage Selector Switch Line voltage low when X-ray power ON.	Position Voltage Selector Switch to match incoming voltage. Measure line regulation. Contact local utility to correct or install buck/booster transformer. Remeasure line regulation after installing transformer; or replace control panel, Part No. 303070
System seems normal, but films are *light.*	Film is underexposed or underdeveloped.	Check Exposure Time Settings, **Page 13.** Increase *or adjust* exposure time. Check **Section VIII, Pages 14-20.**
System seems normal, but films are *dark.*	Film is overexposed or too dark.	Check Exposure Time Settings, **Page 13.** Decrease or adjust exposure time. Check **Section VIII, Pages 14-20.**
	Faulty EEPROM.	Replace control panel, Part No. 303070.
Number 149 flashes & chime sounds 4 times during power ON sequence.	Exposure count at 149 thousand. (Non-volatile RAM stores exposure count; FULL at 150 thousand.)	Replace control panel, Part No. 303070. **Note:** *Failure to replace control panel does not affect X-ray operation, but count stops at 150 thousand.*
Power light & digits do not display.	Primary power OFF.	Check building circuit breaker.
No power light, red or green, but digits display. System operates normally.	Lamp burned out.	Replace power supply cover, Part No. 380411, at the next service call. **Note:** *Operating the X-ray is safe.*
No chime during power ON sequence. System functions normally.	Faulty audio circuit.	Replace control panel, Part No. 303070. **Note:** *Regulations require X-ray exposure signal.*
Exposure indicator: *no* display during power ON sequence. System functions normally.	Faulty exposure indicator circuit.	Replace logic board, Part No. 300486 or control panel, Part No. 303070. **Note:** *Regulations require X-ray exposure light.*
	Faulty digit display or associated circuit.	Replace control panel, Part No. 303070. **Note:** *Do not use Portable X-ray, as time settings cannot be set properly.*

When a problem is reported, verify the complaint. Consult troubleshooting tables and flow chart, wiring diagram, and repair procedures carefully. Repair obvious malfunctions such as burned out lamps and blown fuses first.

Do not attempt to disassemble the tube head. Always return it to the factory for repair or replacement.

Check the system calibration after replacing PC boards or the tube head.

All repairs should be performed by a trained technician to ensure that the system meets radiation safety specifications. Enter dates of adjustments and repairs in the ***Chart 1,Maintenance Record on page 4***.

Fuse Replacement

CAUTION: *Always replace fuses with correct rating and type.*

Fuse	System Rating	Fuse Rating	Circuit
F1, F2	120v	5A, 250 vac	Main Power
F3	120v	1/4A, 250 vac	I/O Board
F1, F2	230-240v	3A, 250 vac	Main Power
F3	230-240v	1/8A, 250 vac	I/O Board

Fuses F1 and F2 are found behind the power switch on the bottom left of the power supply.

Fuse F3 for the I/O Board is found on the bottom right of the power supply.

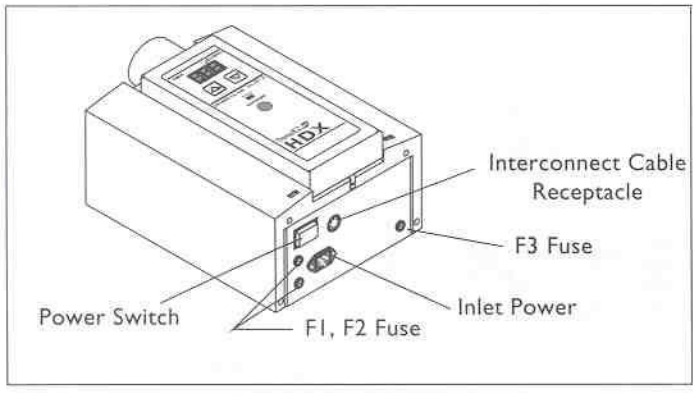


Fig. 28 Fuse & Power Connection Locations

Control Panel Replacement

Unplug exposure switch with cord from control panel.

Using a Phillips screwdriver remove bracket at the bottom of power supply.

Gently press control panel in toward mounting bracket, and slide panel up and off.

Unplug 7-pin and 4-pin connectors from the back of control panel.

Install *new* control panel in reverse order.

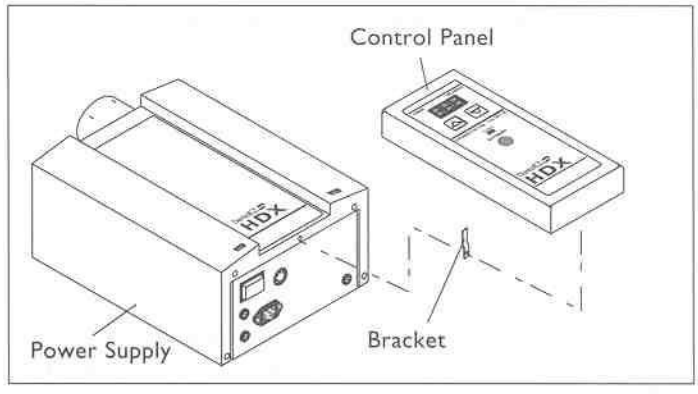


Fig. 29 Mounting of Control Panel

I/O Board Replacement

SHOCK HAZARD: *Dangerous voltages are present on the circuit boards inside the power supply. Turn OFF power to system before removing cover.*

Turn OFF power at circuit breaker.

Remove power supply cover.

SHOCK HAZARD: *Allow 4 minutes for large capacitors (C101 and C102) to safely discharge before removing fuses. Do NOT attempt to discharge capacitors by shorting screw terminals.*

Unplug 7 connectors of the I/O board.

Remove 4 screw terminals securing C101 and C102 to I/O board **OR** loosen clamps retaining C101 and C102.

Remove 3 fasteners securing I/O board. Move board to the left to remove from chassis.

CAUTION: *Be sure to reinstall fishpaper insulator between I/O board and power supply.*

Install *new* I/O board in reverse order.

CAUTION: *Be sure all connectors are properly seated, before turning X-ray ON.*

Note: *Check system calibration after replacing I/O Board.*

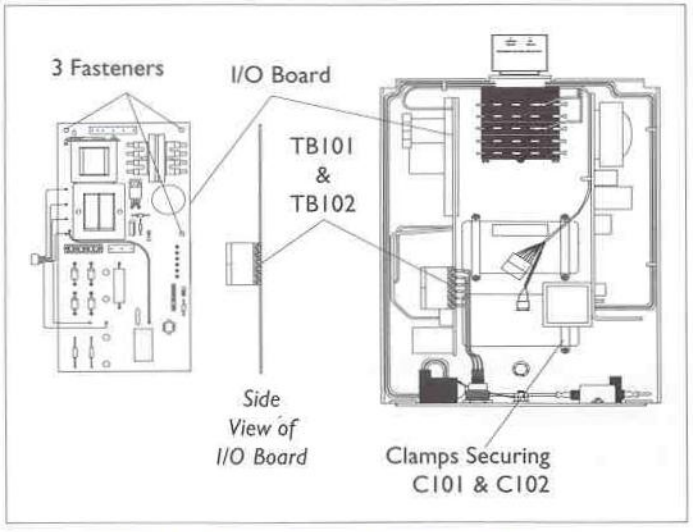


Fig. 30 Mounting of I/O Board

Switcher Board Replacement

SHOCK HAZARD: *Dangerous voltages are present on the circuit boards inside the power supply. Turn OFF power to system before removing cover.*

Disconnect power cord at bottom of power supply assembly.

Remove power supply cover.

SHOCK HAZARD: *Allow 4 minutes for large capacitors (C101 and C102) to discharge safely. Do NOT attempt to discharge capacitors by shorting terminals.*

Unplug 5 connectors.

Remove 4 screws securing switcher board.

Move board to the right to remove from chassis.

CAUTION: *Be sure to reinstall fishpaper insulator between switcher board and power supply.*

Install *new* switcher board in reverse order.

CAUTION: *Make sure all connectors are properly seated.*

Check system calibration after replacing switcher board. Calibrate if necessary.

Note: *Contact* **DentalEZ®** *for return authorization before returning any part (e.g. Tube Head).*

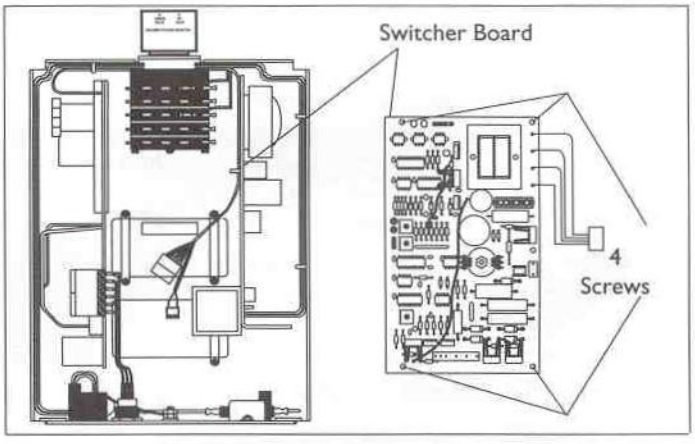


Fig. 31 Mounting of Switcher Board

Procedure to check operation of the Switcher PC Board

Check and verify the operation of the Switcher printed circuit board:

RADIATION HAZARD: *While performing the checking and calibrating procedure, either block the end of the cone with lead or aim the cone in a safe direction away from any person.*

SHOCK HAZARD: *Dangerous voltages are present on circuit boards (including the IC's or integrated circuits) inside power supply. Use extreme caution whenever the power supply cover is removed.*

A. Check operation of LED lights located at top of board:

LED	System Operating Status
CR201	ON = High voltage (kV) circuit enabled
CR202	ON = Filament voltage circuit enabled
CR203	ON = mA and/or kV are absent

B. Verify circuit operation:
   a. Set exposure time to 0.01 seconds.
   b. LED CR203 should be ON; and CR201 and CR202 should be OFF.
   c. Press and hold exposure switch. When exposure is over, the chime sounds once.

CAUTION: *Before taking long exposures, take several 0.10 second exposures to allow the X-ray tube to heat up slowly.*

   d. Press exposure switch. Observe LED CR202 - it lights momentarily.
   e. Increase exposure time to 0.10 seconds.
   f. Press exposure switch. Observe LEDs CR201 and CR203 - CR201 turns ON and CR203 turns OFF momentarily.

Note: *CR203 should be ON when X-ray system is in standby and OFF during an exposure.*

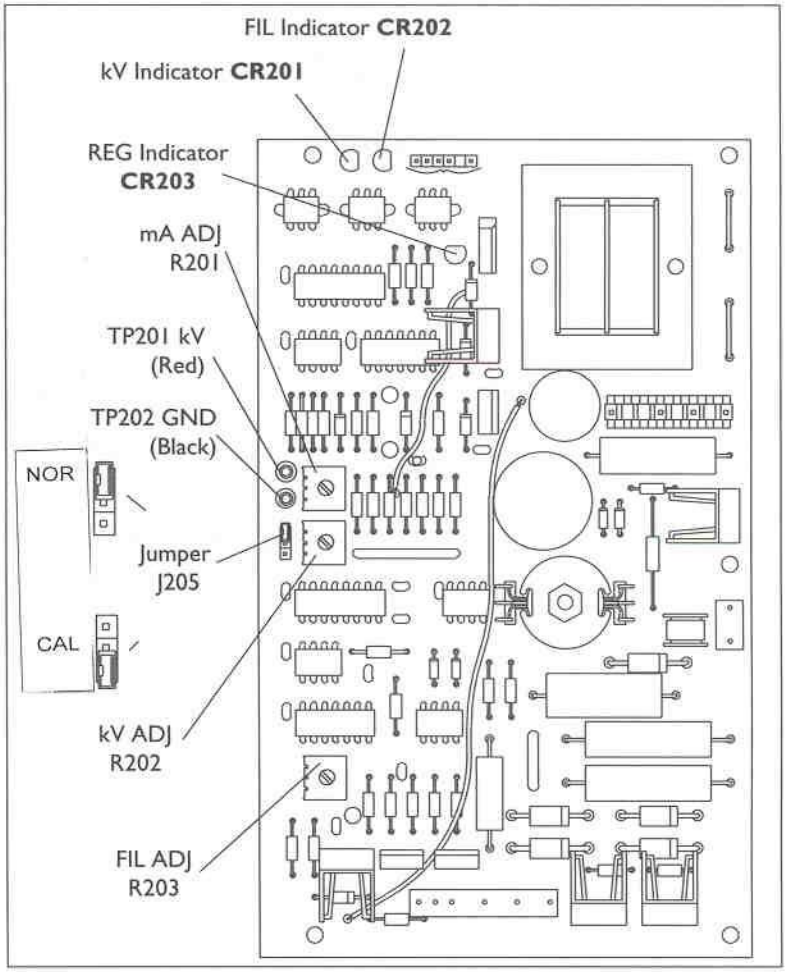
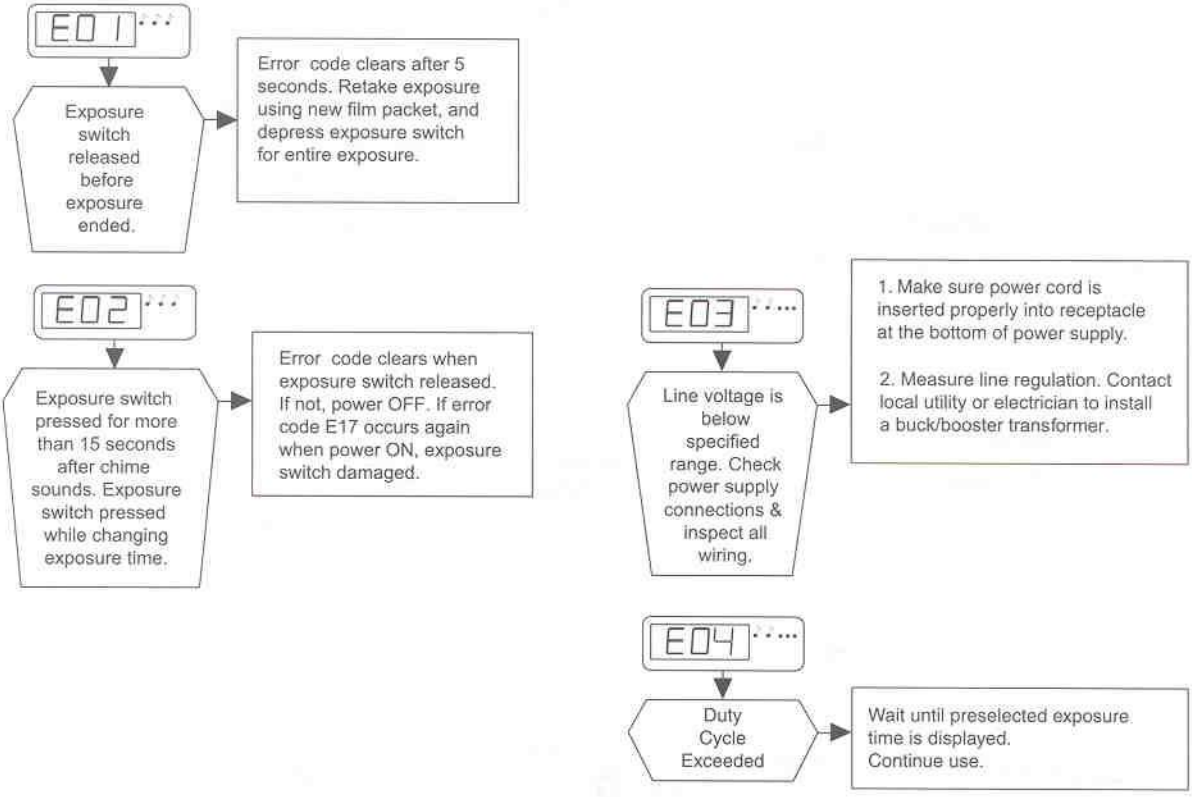


Fig. 32 Switcher Board

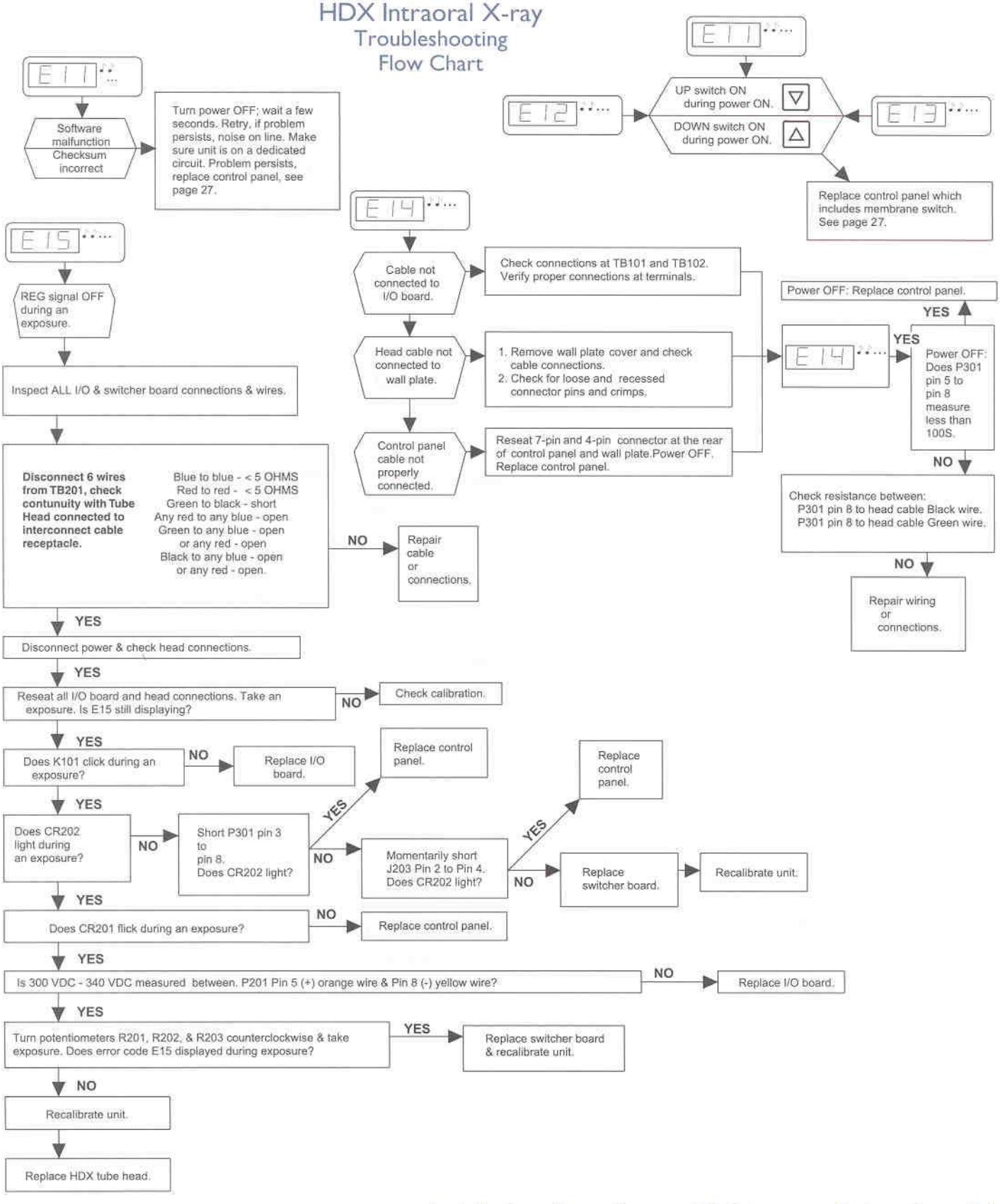
E01-E04 error codes = User Service Information
All other error codes = To be performed by maintenance service personnel ONLY.

Determine a connector's board position by the 1st digit in the identification number:
100 Series = I/O Board
200 Series = Switcher Board
300 Series = Control Panel, Logic Board.

Portable HDX Intraoral X-ray Troubleshooting Flow Chart


E01
Exposure switch released before exposure ended.
Error code clears after 5 seconds. Retake exposure using new film packet, and depress exposure switch for entire exposure.
E02
Exposure switch pressed for more than 15 seconds after chime sounds. Exposure switch pressed while changing exposure time.
Error code clears when exposure switch released. If not, power OFF. If error code E17 occurs again when power ON, exposure switch damaged.
E03
Line voltage is below specified range. Check power supply connections & inspect all wiring.
1. Make sure power cord is inserted properly into receptacle at the bottom of power supply.
2. Measure line regulation. Contact local utility or electrician to install a buck/booster transformer.
E04
Duty Cycle Exceeded
Wait until preselected exposure time is displayed. Continue use.

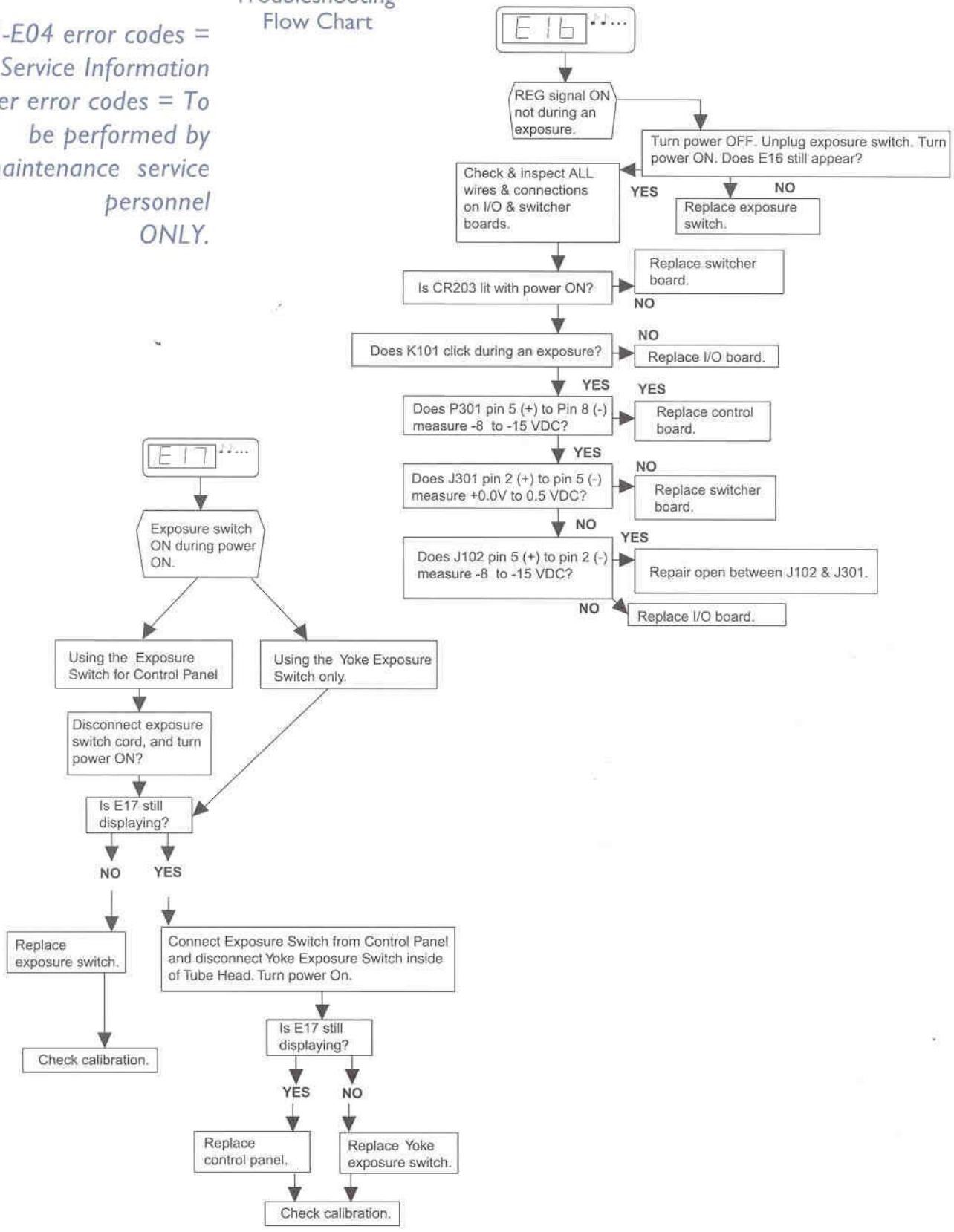
Portable HDX Intraoral X-ray Troubleshooting Flow Chart


E11
Software malfunction Checksum incorrect
Turn power OFF; wait a few seconds. Retry, if problem persists, noise on line. Make sure unit is on a dedicated circuit. Problem persists, replace control panel, see page 27.
E12
E13
UP switch ON during power ON.
DOWN switch ON during power ON.
Replace control panel which includes membrane switch. See page 27.
E14
Cable not connected to I/O board.
Check connections at TB101 and TB102. Verify proper connections at terminals.
Head cable not connected to wall plate.
1. Remove wall plate cover and check cable connections.
2. Check for loose and recessed connector pins and crimps.
Control panel cable not properly connected.
Reseat 7-pin and 4-pin connector at the rear of control panel and wall plate.Power OFF. Replace control panel.
Power OFF: Replace control panel.
YES
E14
YES
Power OFF: Does P301 pin 5 to pin 8 measure less than 100S.
NO
Check resistance between: P301 pin 8 to head cable Black wire. P301 pin 8 to head cable Green wire.
NO
Repair wiring or connections.
E15
REG signal OFF during an exposure.
Inspect ALL I/O & switcher board connections & wires.
Disconnect 6 wires from TB201, check contunuity with Tube Head connected to interconnect cable receptacle.
Blue to blue - < 5 OHMS
Red to red - < 5 OHMS
Green to black - short
Any red to any blue - open
Green to any blue - open or any red - open
Black to any blue - open or any red - open.
NO
Repair cable or connections.
YES
Disconnect power & check head connections.
YES
Reseat all I/O board and head connections. Take an exposure. Is E15 still displaying?
NO
Check calibration.
YES
Does K101 click during an exposure?
NO
Replace I/O board.
YES
Does CR202 light during an exposure?
NO
Short P301 pin 3 to pin 8. Does CR202 light?
YES
Replace control panel.
NO
Momentarily short J203 Pin 2 to Pin 4. Does CR202 light?
YES
Replace control panel.
NO
Replace switcher board.
Recalibrate unit.
YES
Does CR201 flick during an exposure?
NO
Replace control panel.
YES
Is 300 VDC - 340 VDC measured between. P201 Pin 5 (+) orange wire & Pin 8 (-) yellow wire?
NO
Replace I/O board.
YES
Turn potentiometers R201, R202, & R203 counterclockwise & take exposure. Does error code E15 displayed during exposure?
YES
Replace switcher board & recalibrate unit.
NO
Recalibrate unit.
Replace HDX tube head.

DentalEZ

HDX Intraoral X-ray Troubleshooting Flow Chart

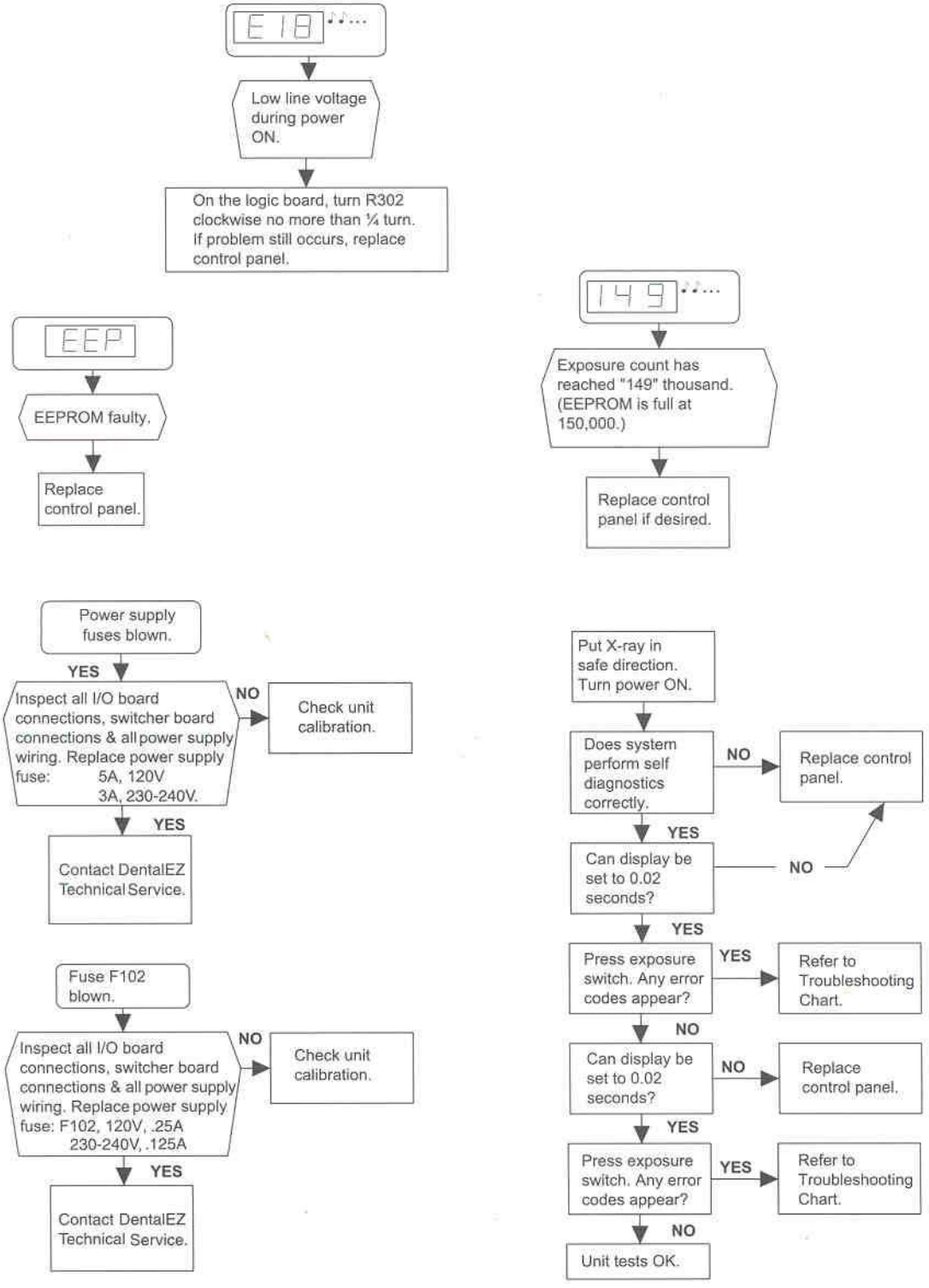
E01-E04 error codes = User Service Information
All other error codes = To be performed by maintenance service personnel ONLY.


E16
REG signal ON not during an exposure.
Turn power OFF. Unplug exposure switch. Turn power ON. Does E16 still appear?
YES
NO
Replace exposure switch.
Check & inspect ALL wires & connections on I/O & switcher boards.
Is CR203 lit with power ON?
Replace switcher board.
NO
Does K101 click during an exposure?
NO
Replace I/O board.
YES
Does P301 pin 5 (+) to Pin 8 (-) measure -8 to -15 VDC?
YES
Replace control board.
YES
Does J301 pin 2 (+) to pin 5 (-) measure +0.0V to 0.5 VDC?
NO
Replace switcher board.
NO
Does J102 pin 5 (+) to pin 2 (-) measure -8 to -15 VDC?
YES
Repair open between J102 & J301.
NO
Replace I/O board.
E17
Exposure switch ON during power ON.
Using the Exposure Switch for Control Panel
Using the Yoke Exposure Switch only.
Disconnect exposure switch cord, and turn power ON?
Is E17 still displaying?
NO
YES
Replace exposure switch.
Check calibration.
Connect Exposure Switch from Control Panel and disconnect Yoke Exposure Switch inside of Tube Head. Turn power On.
Is E17 still displaying?
YES
NO
Replace control panel.
Replace Yoke exposure switch.
Check calibration.

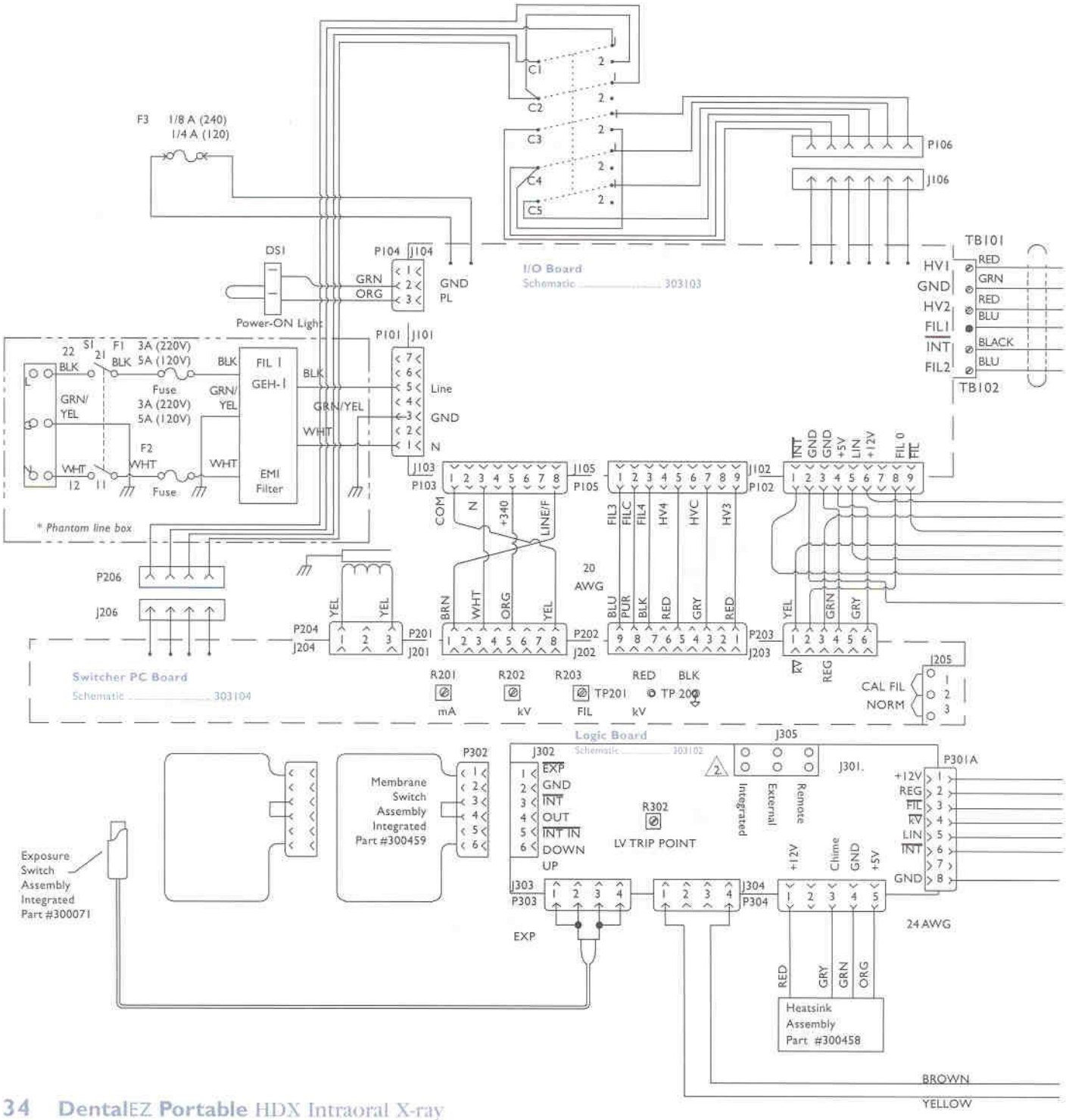
E01-E04 error codes = User Service Information
All other error codes = To be performed by maintenance service personnel ONLY.

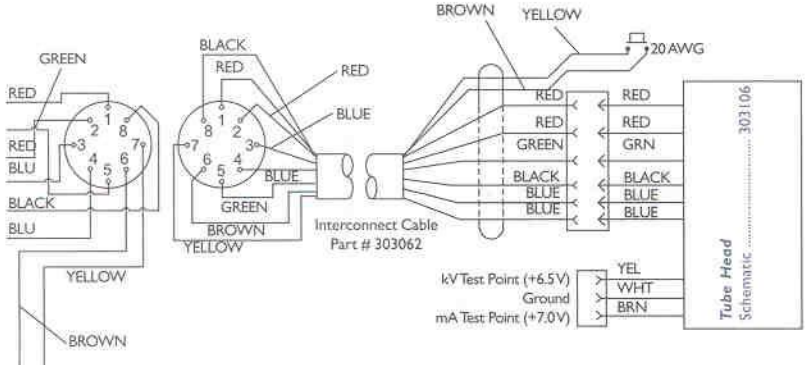
Determine a connector's board position by the 1st digit in the identification number:
100 Series = I/O Board
200 Series = Switcher Board
300 Series = Control Panel, Logic Board.

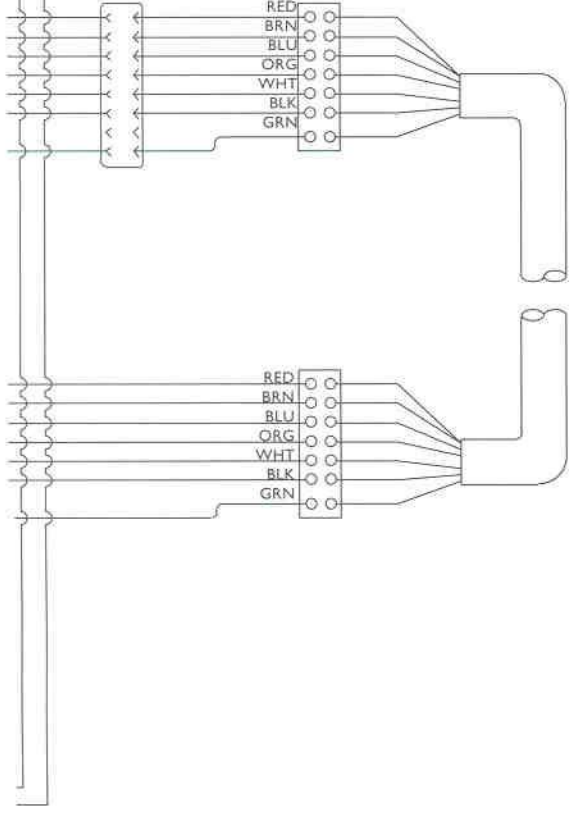
Portable HDX Intraoral X-ray Troubleshooting Flow Chart


E18
Low line voltage during power ON.
On the logic board, turn R302 clockwise no more than ¼ turn. If problem still occurs, replace control panel.
EEP
EEPROM faulty.
Replace control panel.
149
Exposure count has reached "149" thousand. (EEPROM is full at 150,000.)
Replace control panel if desired.
Power supply fuses blown.
YES
Inspect all I/O board connections, switcher board connections & all power supply wiring. Replace power supply fuse: 5A, 120V 3A, 230-240V.
NO
Check unit calibration.
YES
Contact DentalEZ Technical Service.
Fuse F102 blown.
Inspect all I/O board connections, switcher board connections & all power supply wiring. Replace power supply fuse: F102, 120V, .25A 230-240V, .125A
NO
Check unit calibration.
YES
Contact DentalEZ Technical Service.
Put X-ray in safe direction. Turn power ON.
Does system perform self diagnostics correctly.
NO
Replace control panel.
YES
Can display be set to 0.02 seconds?
NO
YES
Press exposure switch. Any error codes appear?
YES
Refer to Troubleshooting Chart.
NO
Can display be set to 0.02 seconds?
NO
Replace control panel.
YES
Press exposure switch. Any error codes appear?
YES
Refer to Troubleshooting Chart.
NO
Unit tests OK.

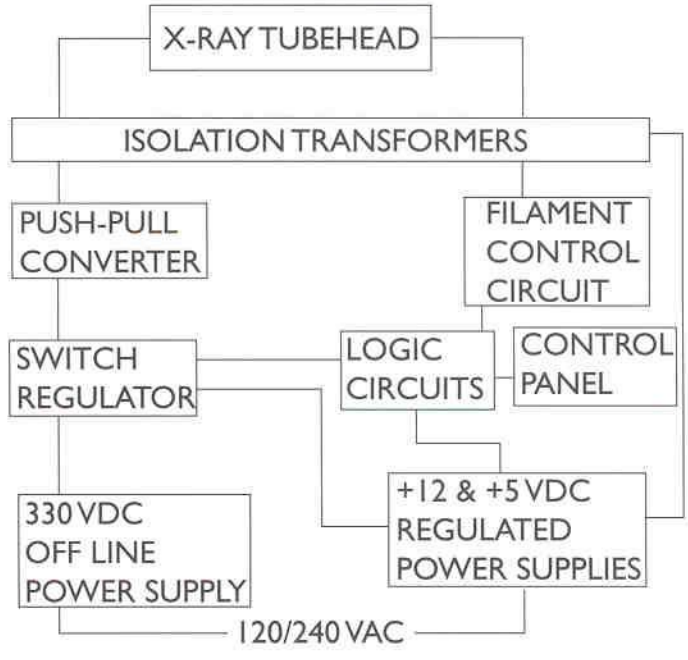
Portable HDX Intraoral X-ray
Wiring Diagram 303105





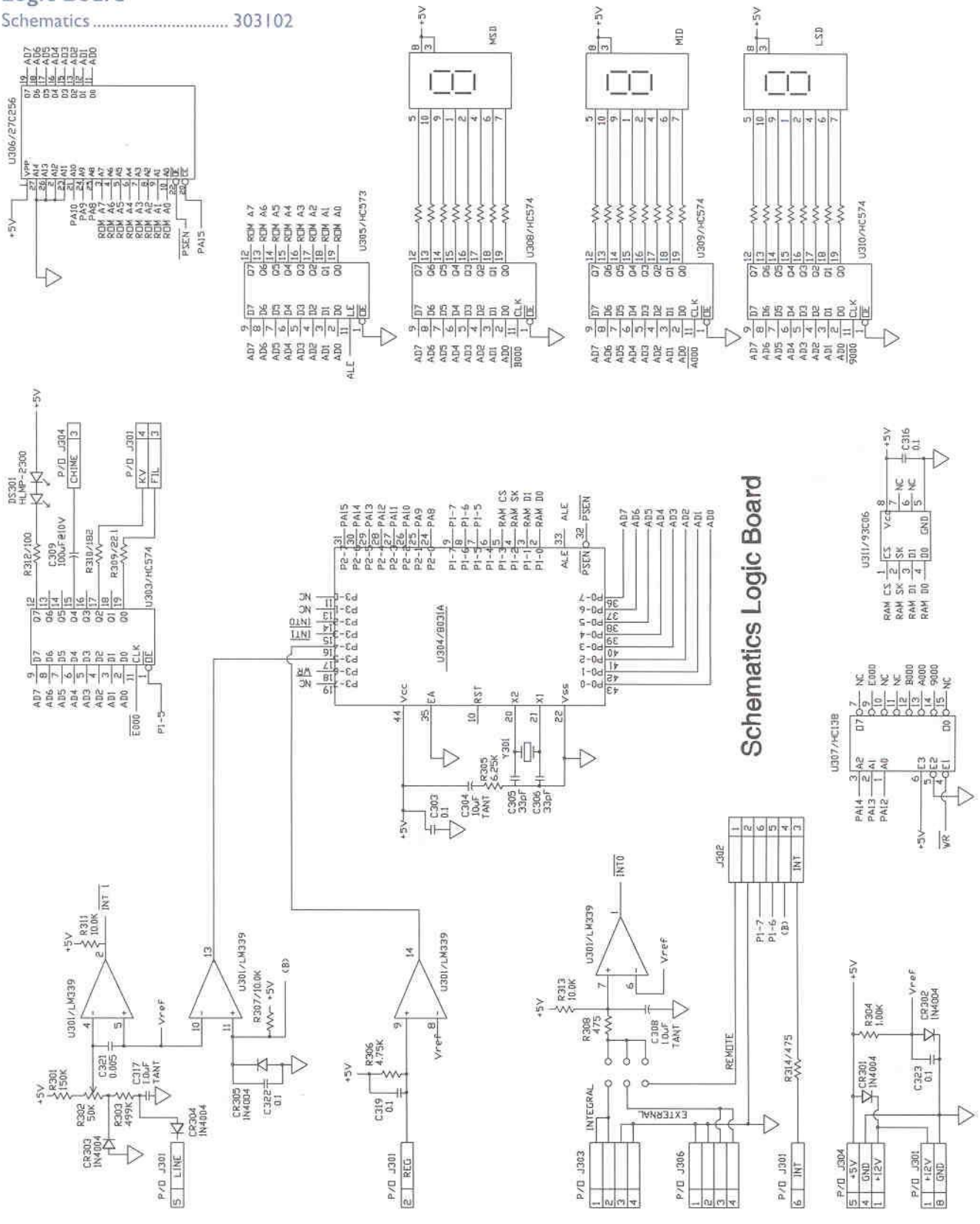


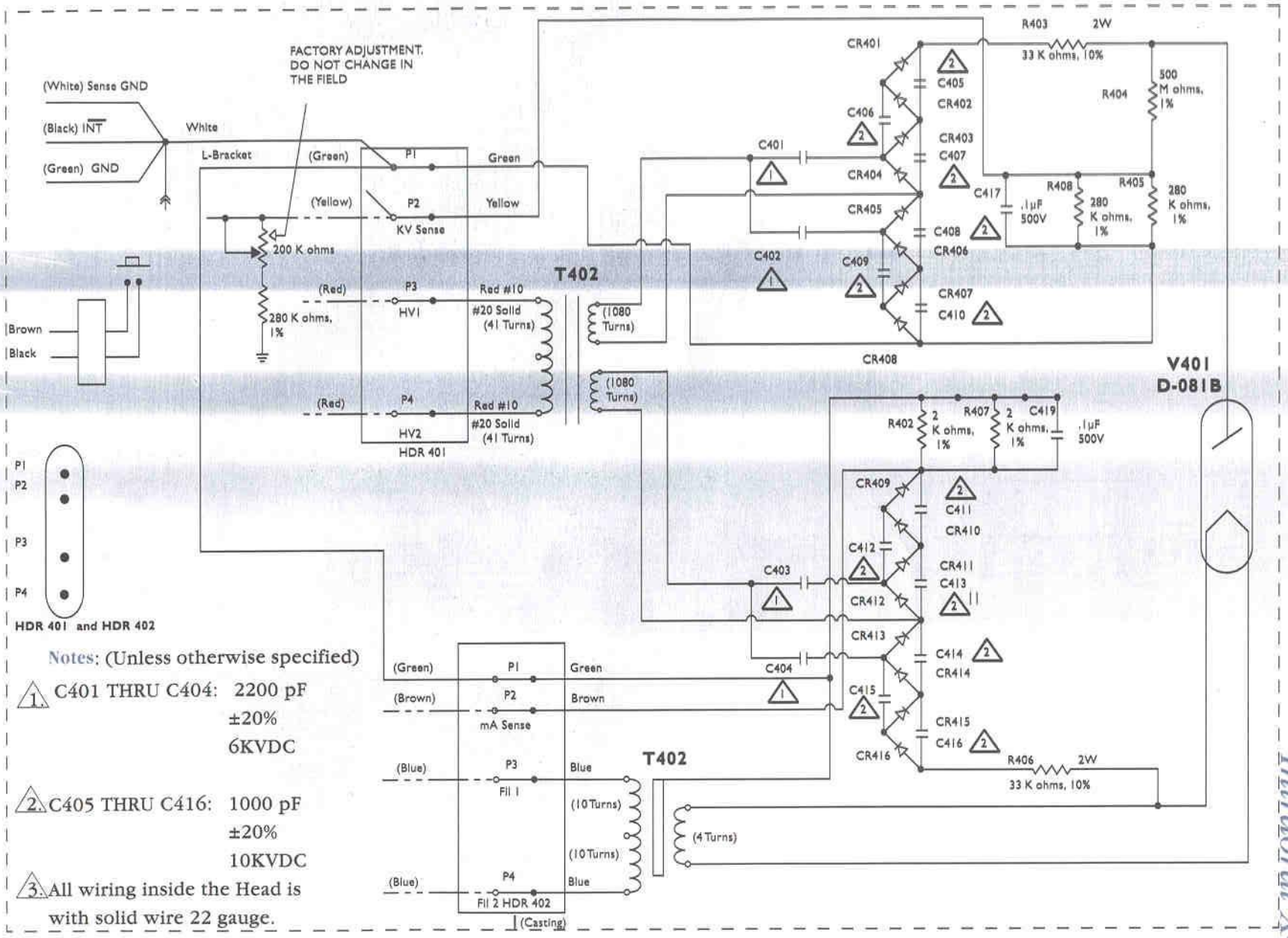
Portable HDX Intraoral X-ray
Block Diagram



Logic Board

Schematics 303102





Notes: (Unless otherwise specified)

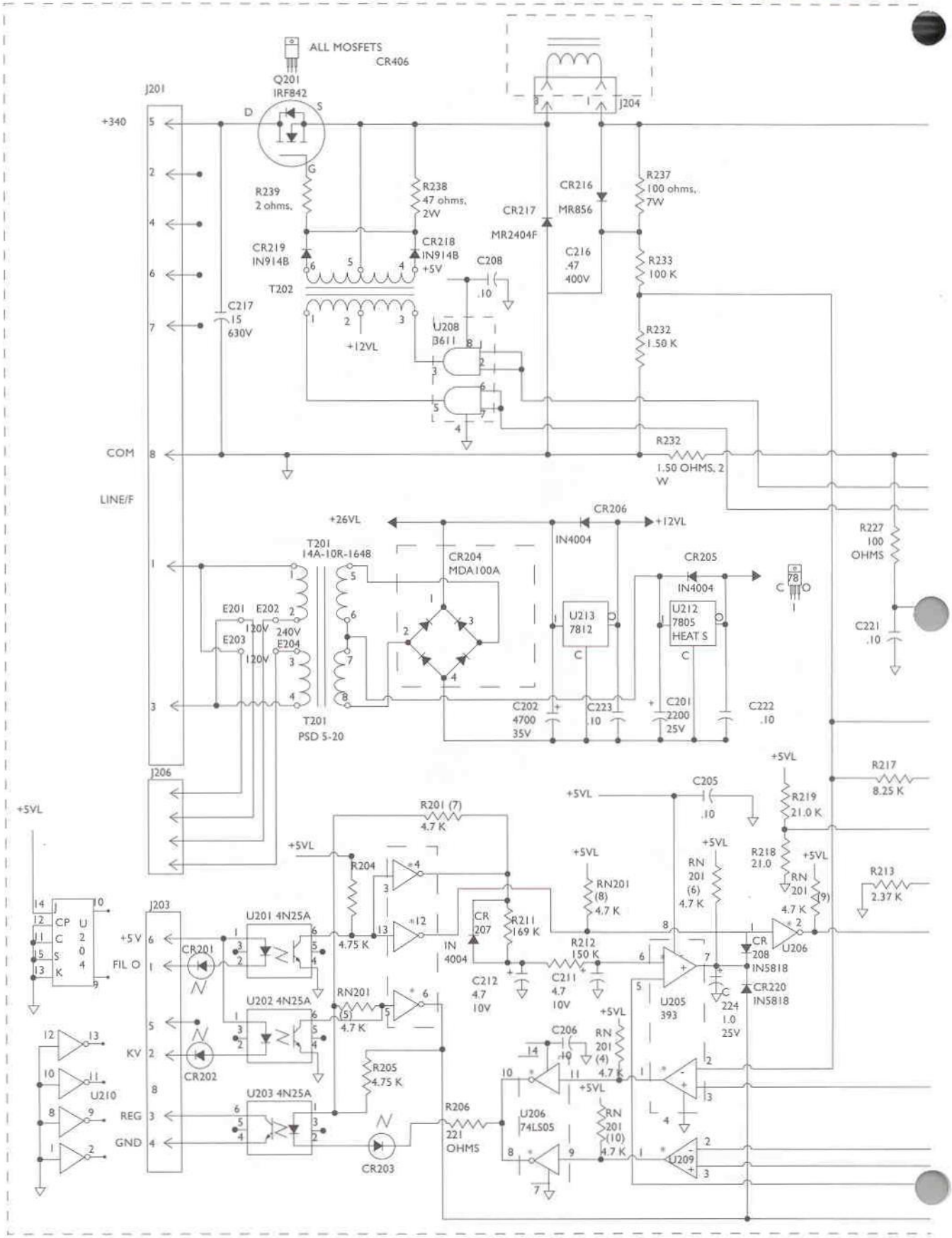
1. C401 THRU C404: 2200 pF ±20% 6KVDC

2. C405 THRU C416: 1000 pF ±20% 10KVDC

3. All wiring inside the Head is with solid wire 22 gauge.

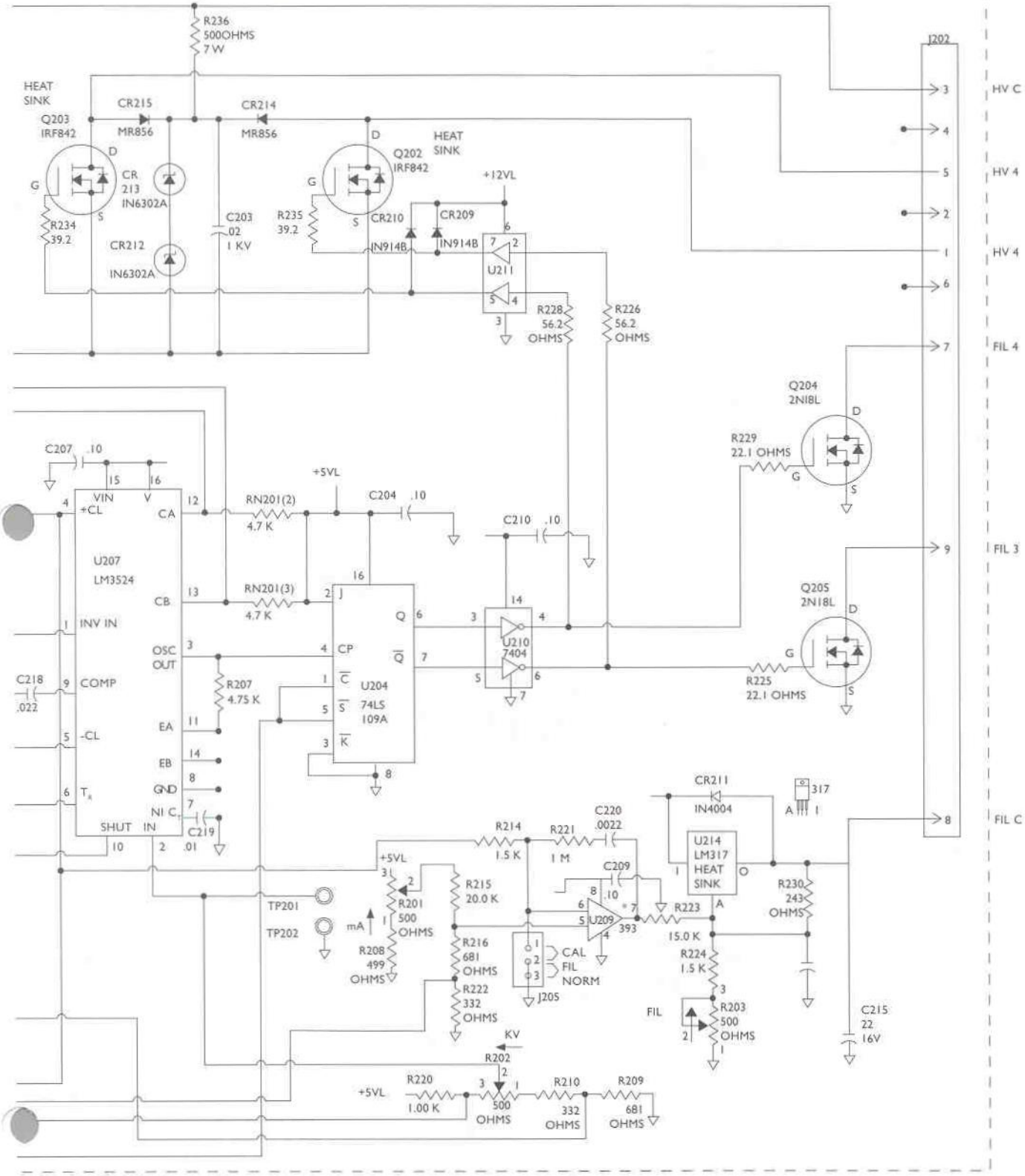
Tube Head Circuit Diagram

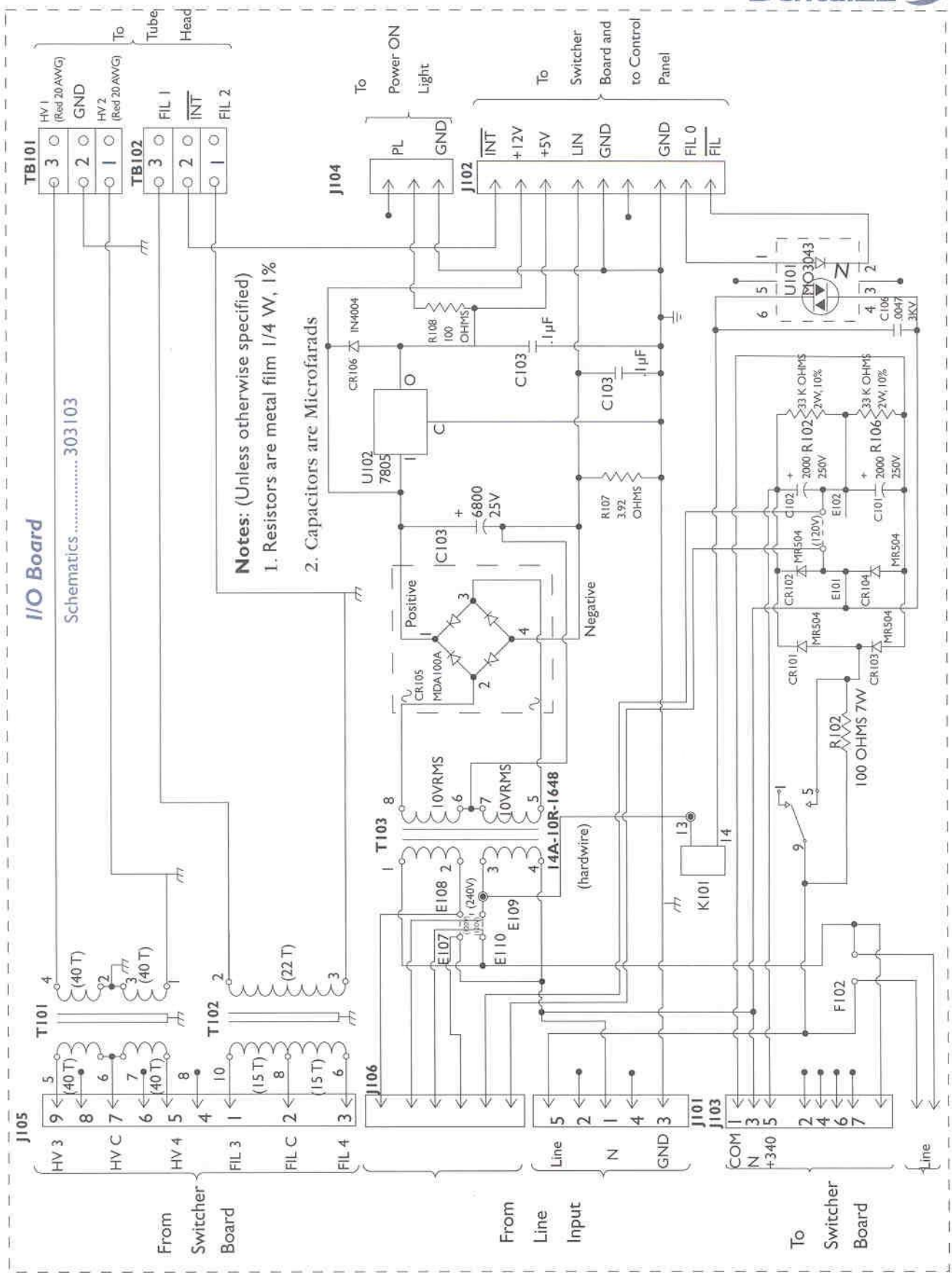
Schematics 303106


NOTES UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE METAL FILM, 1/4W, 1%
2. CAPACITORS VALUES ARE IN MICROFARDS.
3. COM(-) IS AT 170V WITH RESPECT TO GROUND. ALL I2C VOLTAGES ARE AT DANGEROUS LEVELS.
ALL MOSFETS
CR406
Q201
IRF842
J201
J204
+340
COM
LINE/F
R239
2 ohms,
R238
47 ohms,
2W
CR219
IN914B
CR218
IN914B
+5V
T202
+12VL
C208
.10
C217
.15
630V
CR216
MR856
CR217
MR2404F
C216
.47
400V
R237
100 ohms,
7W
R233
100 K
R232
1.50 K
U208
B611
R232
1.50 OHMS, 2
W
R227
100
OHMS
C221
.10
+26VL
+12VL
CR206
IN4004
T201
14A-10R-1648
CR204
MDA100A
CR205
IN4004
U213
7812
U212
7805
HEAT S
E201
E202
E203
E204
120V
240V
120V
T201
PSD 5-20
C202
4700
35V
C223
.10
C201
2200
25V
C222
.10
J206
+5VL
R201 (7)
4.7 K
R204
4.75 K
U201 4N25A
U202 4N25A
U203 4N25A
J203
+5V
FIL O
KV
REG
GND
CR201
CR202
CR203
U210
RN201
(5)
4.7 K
R205
4.75 K
R206
221
OHMS
CR
207
IN
4004
R211
169 K
C212
4.7
10V
C211
4.7
10V
RN201
(8)
4.7 K
R212
150 K
U205
393
C205
.10
R219
21.0 K
RN
201
(6)
4.7 K
R218
21.0
RN
201
(9)
4.7 K
R217
8.25 K
R213
2.37 K
CR
208
IN5818
CR220
IN5818
C224
1.0
25V
C206
.10
RN
201
(4)
4.7 K
U206
74LS05
RN
201
(10)
4.7 K
U209

Switcher PC Board

Schematics 303104




I/O Board
Schematics.....303103
Notes: (Unless otherwise specified)
1. Resistors are metal film 1/4 W, 1%
2. Capacitors are Microfarads
TB101
TB102
HV 1 (Red 20 AWG)
GND
HV 2 (Red 20 AWG)
FIL 1
INT
FIL 2
To Tube Head
J104
PL
GND
To Power ON Light
J102
INT
+12V
+5V
LIN
GND
GND
FIL 0
FIL
To Switcher Board and to Control Panel
U102 7805
CR106 IN4004
R108 100 OHMS
C103 .1µF
C103 6800 25V
R107 3.92 OHMS
U101 MO3043
C106 .0047 3KV
R103 33 K OHMS 2W, 10%
R102 33 K OHMS 2W, 10%
C102 2000 250V
C101 2000 250V
E102
E101
MR504
CR102
CR104
CR101
CR103
R102 100 OHMS 7W
F102
K101
T101
T102
T103
(40 T)
(22 T)
(15 T)
10VRMS
14A-10R-1648
(hardwire)
E107
E108
E109
E110
J105
J106
J101
J103
HV 3
HV C
HV 4
FIL 3
FIL C
FIL 4
Line
N
GND
COM
N
+340
Line
From Switcher Board
From Line Input
To Switcher Board

Item	Part#	Description - * Certified Component	Vendor	Vendor P/N	Cage#
1	303068	Board, I/O. (OEM: DentalEZ)	DentalEZ	————	———
2	303067	Board, Switcher. (OEM: DentalEZ)	DentalEZ	————	———
3	300481	Bracket, Control Panel Mounting.	DentalEZ	————	———
4	303046	Plug, Dome.	Heyco	2784	28520
5	303088	Cone, Round, 20 cm	DentalEZ	————	———
6	300926	Control Cover	DentalEZ	————	———
7*	303070	Control Panel Assembly	DentalEZ	————	———
8	303050	Cord, Power, 120V	Panel Components	86610710	5F520
9	380411	Cover, Power Supply	DentalEZ	————	———
10	300433	Power Switch	Microswitch	AML31EBA4AD	91929
11	303044	Shield, Scatter, Cone	DentalEZ	————	———
12	303062	Interconnect Cable w/connector	DentalEZ	————	———
13	303051	Cord Power 240 V	Panel Components	0006020300	5F520
14	303060	Switch, Yoke w/connector	DentalEZ	————	———
15	300337	Cover Set, Plastic Head	DentalEZ	————	———
16	303052	Cap, Yoke	DentalEZ	————	———
17	300524	Filter, Line	Corcom	6EH1	05245
18	300564	Fuse, 5 Amp, 120V	Bussman	MDL 5	71400
19	300565	Fuse, 3 Amp, 230-240V	Bussman	MDL 3	71400
20	300558	Fuse, .125 Amp, 230-240V	Bussman	MDL 1/8	71400
21	300571	Fuse, .25 Amp, 120V	Bussman	MDL 1/4	71400
22	300747	O-Ring, Cone	Apple	221-70 BN	62351
23	300071	Exposure Switch with Coil Cord	DentalEZ	————	———
24*	303049	Tube Head Assembly Portable HDX Intraoral X-ray	DentalEZ	————	———
25	303048	Power Supply Assembly Portable HDX Intraoral X-ray	DentalEZ	————	———
26	303045	Carrier Case for Portable HDX Intraoral X-ray	DentalEZ	————	———
27	303040	Bracket, Control Panel	DentalEZ	————	———
28	303055	Voltage Selector Switch	NKK Switches	HS16-5N	63426

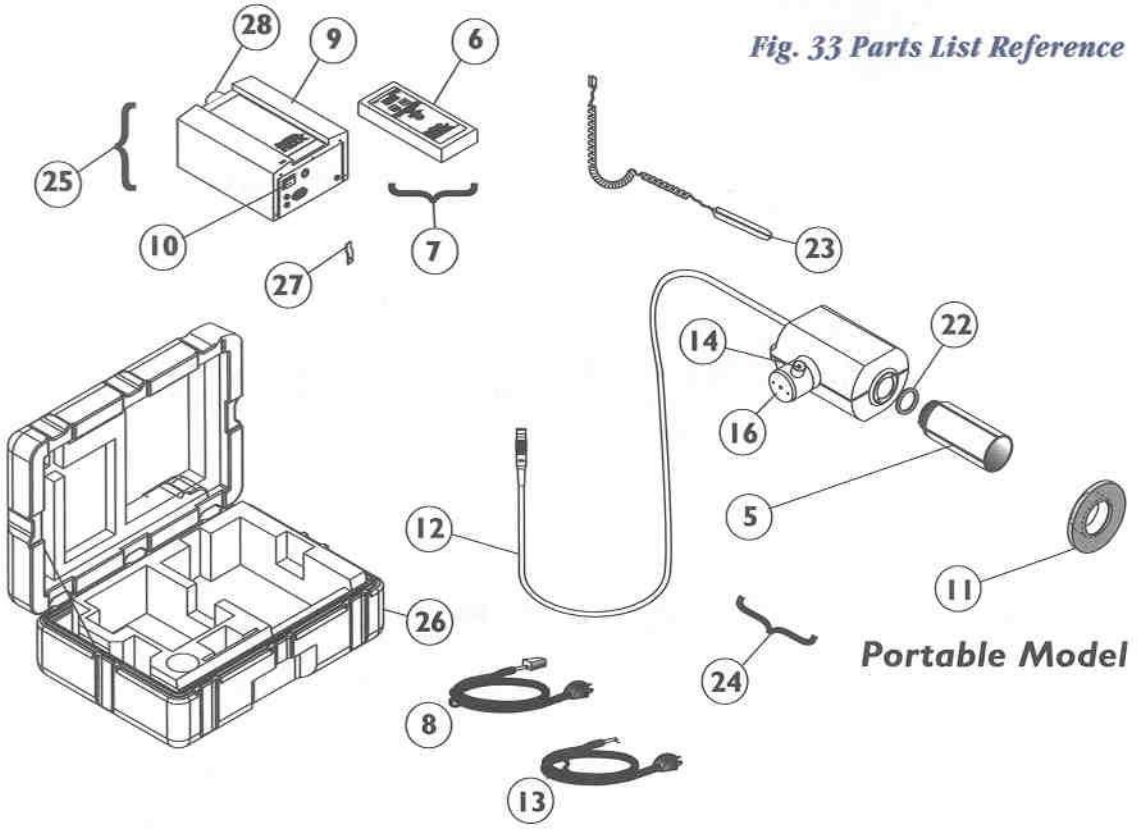


Fig. 33 Parts List Reference

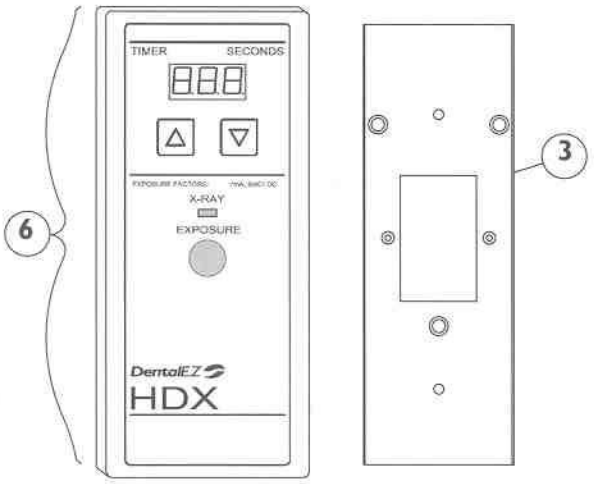


Fig. 34

Control Panel

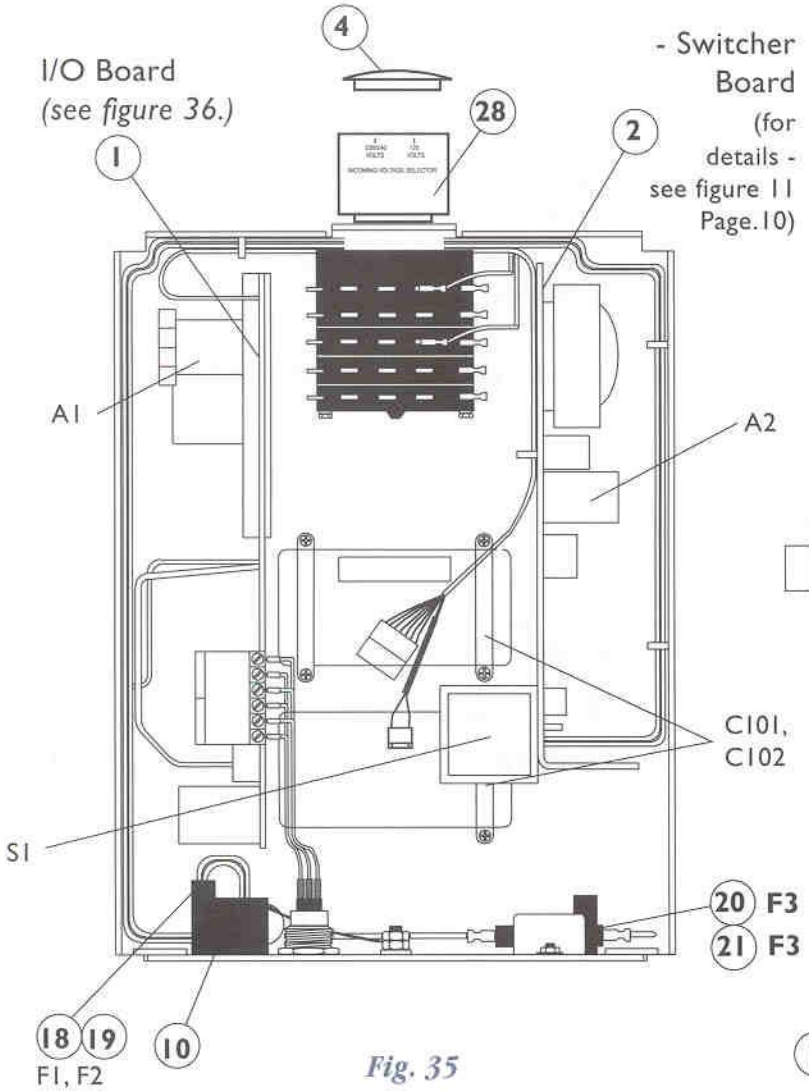


Fig. 35

Power Supply Assembly Detail

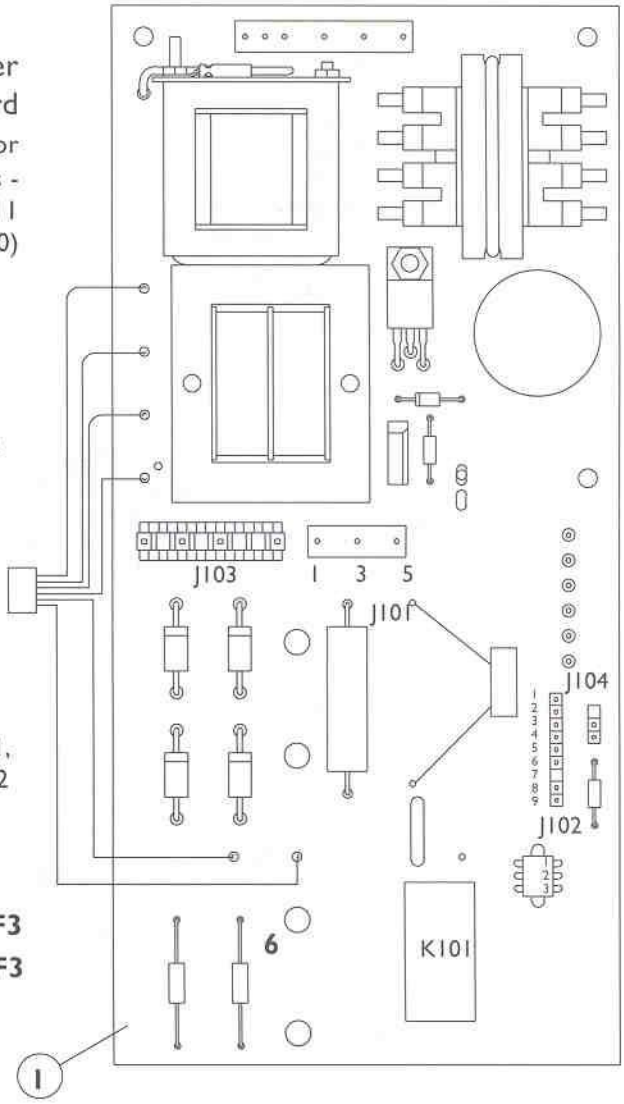


Fig. 36

I/O Board

Classification:

Complies with for UL2601-1:1997/CSA601.1-M90 and EN60601-1:1990+A1+A2
Complies with DHHS Radiation Performance Standard, 21 CFR Subchapter J.
Protection against electrical shock: Class I.
Degree of protection: Type B.
Protection against ingress of liquids: Ordinary
Disinfection methods:
-mild soapy water
-non-alcohol based disinfectant for cone (BLD).
For use in environments where no flammable anesthetics and/or flammable cleaning agents are present.
Mode of operation: Standby with intermittent loading.
Applied part with no conductive connection to patient.

Description:

The DentalEZ HDX X-ray is a dental Intraoral X-ray system with a high frequency switching mode X-ray generator and tube housing assembly, and is designed for dental use only and must be operated by a dentist or by the authorized staff.

Tube Housing Assembly:
X-ray tube:

Model number:	D-081B (stationary anode).
Manufacturer:	Toshiba Corporation, Tokyo, Japan.
Focal spot:	0.8 mm x 0.8 mm.
X-ray tube target angle:	20 degrees with respect to the central ray.
Target material:	Tungsten.
Operating tube potential:	
Maximum voltage:	65 kV fixed.
Maximum tube current:	See rating charts.
Operating tube current:	7 mA fixed.
X-ray tube inherent filtration:	At least 0.8 mm Al. equivalent at 50 kV.
Tube rating chart:	See tube rating chart.
Anode Cooling curve:	See Anode cooling curve.
Thermal Characteristics:	
Anode heat storage capacity:	6.0 kJ (8.5 kHU)
Max. anode heat dissipation rate:	128 W (180 HU/s)

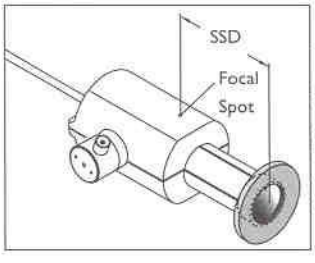
Generator:

Maximum output power:	455 W nominal at 65 kV, 7 mA.
kV wave form:	Constant potential (DC).
Duty cycle:1	:60 (one 0.25 second exposure every 15 seconds)
Leakage technique factors[1]:	65 kV / 0.12 mA.
Minimum filtration permanently in useful beam:	1.5 mm A1 equivalent at 65 kV.
Tube housing cooling curve:	See Tube housing cooling curve.
Primary protective shielding:	Minimum 0.37 mm Pb or equivalent.
Outer shell temperature:	50°C maximum.

1. 0.12 mA is the maximum rated continuous tube current equivalent to 7 mA with a duty cycle of 1:60.

Cone (Beam Limiting device):

Only the following DentalEZ cone (BLD) is compatible with the Portable HDX x-ray system *(see next column)*:



The small circles on the top and bottom of the tube housing assembly indicate the location, along the central ray axis, of the focal spot (tube target). Measure the minimum source-skin distance (SSD) from the focal spot as shown.

P/N	Minimum Source-skin distance	Cone tip configuration & field size
303088	20 cm	Round - 6.3 cm

Tube Housing Assembly:

Nominal dose output at cone tip:
20 cm cone - 1.5 R/second.
Cooling curves: See Cooling curve.

X-ray Controls and Generator:

Rated nominal line voltage:	120V	230-240V
Line Frequency:	50/60 Hz	50/60 Hz
Phase:	Single	Single
Permissible maximum line voltage regulation:	4%	4%
Maximum line current:	11A	5.5A
Technique factors at maximum line current:	65 kV/7mA	65 kV/7mA
Duty cycle:	1:60 (one 0.25 second exposure every 15 seconds).	
Time range:	0.01 - 2.00 seconds in 0.01 second increments.	

Maximum deviation from indicated values:

kV:	+/-5 kV
mA:	+/-25% for T = 0.01 seconds +/-10% for T > 0.01
Time:	0.01 seconds or +/-1% (whichever is greater).

Measurement Base of Technique Factors:

The kV is measured by using a built-in voltage divider with an accuracy of +/-2%, and a digital multimeter. Tube current is measured using a sampling resistor with an accuracy of +/-1%, and a digital multimeter. Exposure time is measured by a crystal controlled counter with a base accuracy of better than 0.1%. Exposure time begins when the X-ray light on the control panel illuminates, and ends upon activation of the audible chime.

Electrical Specifications:

Input voltage:	120VAC	230-240 VAC
Line frequency:	50/60Hz	50/60 Hz
Phase:	Single	Single
Permissible maximum line voltage regulation:	4%	4%
Maximum apparent resistance of supply mains:	0.65 Ohms	
Maximum line current:	11A	5.5A
Line Circuit breaker:	15A	10A
Maximum stand-by current:	0.2 Amps	0.1 Amps

Maximum line fusing (F1 and F2):
120V: 5 Amp., 250V 230-240V: 3 Amp., 250V.
Exposure switch and cable:
A "deadman" type exposure switch on a coiled cord which stretches 3.66 m long is provided.

Environmental Specifications:

Operation:	Temperature:	10°C to 45°C
	Relative Humidity:	5 to 90% non-condensing.
	Altitude:	Sea level to 3,000 m
Shipment & Storage:	Temperature:	-23°C to 71°C
	Altitude:	Sea level to 3,700 m
	Relative Humidity:	5 to 95% non-condensing.

Section XIII Technical Specifications

ELECTROMAGNETIC INTERFERENCE:

The Portable HDX Intraoral x-ray is designed to meet the following standards as they relate to Electromagnetic Interference (EMI): EN 60601-1-2, IEC 801-2: 1991, IEC 801-3: Draft, IEC 801-4: 1988, and IEC 801-5: Draft. In order to assure continued system operation to EMI performance levels within allowable limits, do not remove or modify any of the EMI control devices. Precaution should be taken when using this device in the presence of electrical devices, electromagnetic emissions may cause interference with other devices in the vicinity.

SYSTEM DISPOSAL AT END OF USEFUL LIFE ADVICE:

The Portable HDX Intraoral x-ray, with exception of the transformer oil inside of the tube head, can be disposed of in the same way as any electronic product. In regard to disposing the oil, puncture the aluminum window in the front center of the tube head (where the cone is attached). Drain the oil into a clean container, then dispose of it in accordance to local requirements.

Chart5.

MAXIMUM RATING CHARTS

(ABSOLUTE MAXIMUM RATING CHARTS)

SELF-RECTIFIED

FOCAL SPOT: 0.8 mm

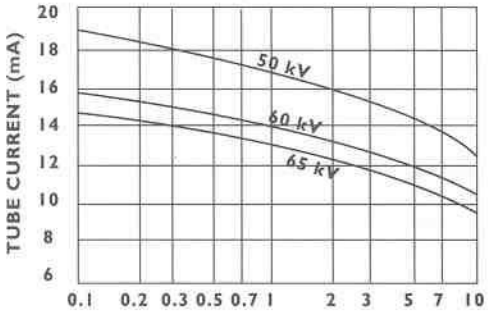
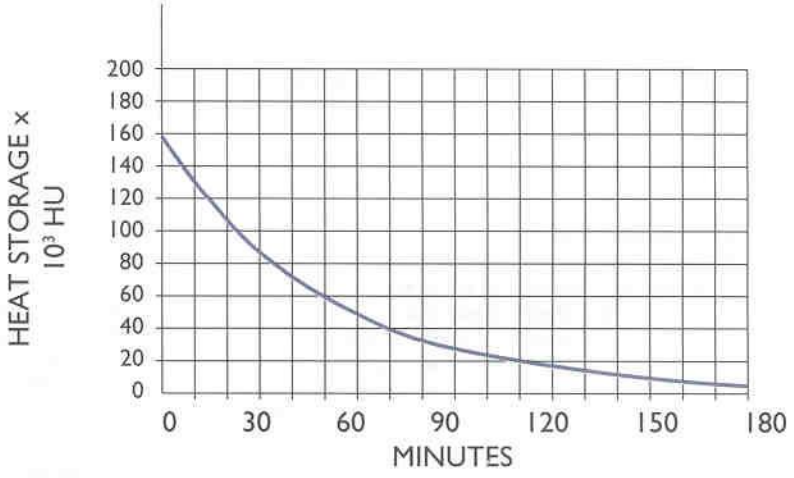
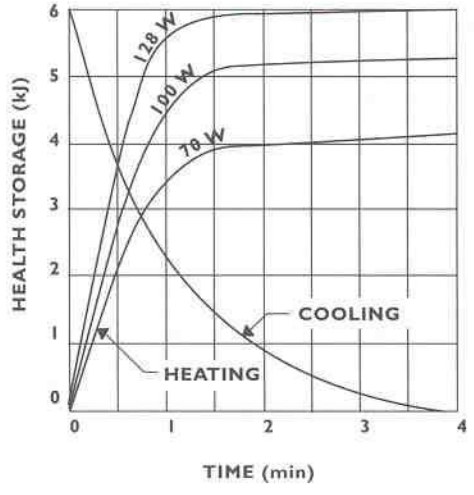


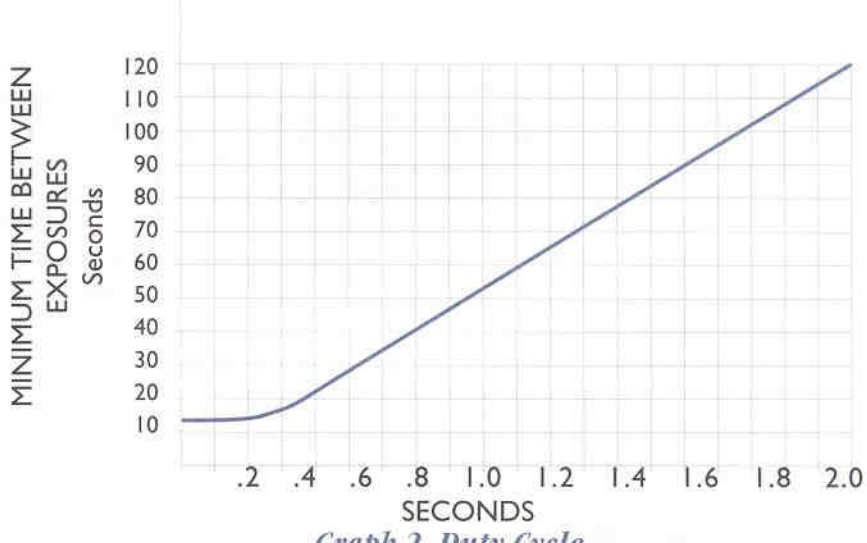
Chart 6. EXPOSURE TIME(s)



Graph 1 Housing Cooling Curve

ANODE THERMAL CHARACTERISTICS





Graph 2. Duty Cycle

DentalEZ® warrants the HDX Intraoral X-ray to be free of defects in material and workmanship, under normal usage for a period of one (1) year from the date of installation.

Please note the following additional terms of our warranty and return policy:

- Warranties cover manufacturing defects only and do not cover costs resulting from abuse, improper handling, cleaning, care or maintenance, normal wear and tear on non-observance of operating, maintenance or installation instructions.

- **Liability is limited to repair or replacement of the defective product at our sole discretion. All other liabilities, in particular liability for damages, including, without limitation, consequential or incidental damages are excluded.**

- THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. NO EMPLOYEE, REPRESENTATIVE OR DEALER IS AUTHORIZED TO CHANGE THIS WARRANTY IN ANY WAY OR TO GRANT ANY OTHER WARRANTY.

If product return is required, we will provide you with a **Return Authorization** number and shipping instructions to return the product to the proper facility. If the product is under warranty we will ask you to provide serial number on power supply. Please be sure to include the **Return Authorization** number on the package you are returning. **Products returned without a return authorization number cannot be repaired or given credit consideration**.

Freight costs for product returns are the responsibility of the customer. Products under warranty will be repaired or replaced, at our sole discretion, and returned at our expense. Products outside the warranty limits will be repaired and returned with costs invoiced to the customer. We are not responsible for shipping damages. We will, however, help you file a claim with the freight carrier. Written repair estimates are available. Out of warranty repaired products are protected by a six-month warranty. In warranty repairs or replaced products are covered for the duration of the original warranty.